

**REPORT
OF
RURAL ELECTRIC SERVICE
COMMITTEE
1924-1925**

**To be presented at the Forty-eighth
Convention, San Francisco, Cal.
June 15 to 19, 1925**

**NATIONAL ELECTRIC LIGHT ASSOCIATION
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FOREWORD

This report has been prepared and edited by the
RURAL ELECTRIC SERVICE COMMITTEE
 for presentation at the Forty-eighth Convention of the
 Association, at San Francisco, Cal., June 15 to 19, 1925

PERSONNEL OF THE COMMITTEE

Chairman, G C NEFF, Wisconsin Power and Light Company,
 Madison, Wis
 P P ASHWORTH, Utah Power & Light Co, Salt Lake City, Utah
 C A ATHERTON, National Lamp Works of G E Co, Cleveland, Ohio
 F H BROOKS, Continental Gas & Elect Corp, Omaha, Nebr
 J W CARPENTER, Texas Power & Light Co, Dallas, Texas
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 J E HILLEMAYER, Union Elect Lt & Pr Co, Webster Grove, Mo
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 PHIL H PALMER, Indiana Railway & Light Co, Kokomo, Ind
 BERT H PECK, Illinois Power & Light Corp, St Louis, Mo
 CHARLES F STUART, Northern States Power Co, Minneapolis, Minn
 W K VANDERPOEL, Public Service Elect & Gas Co, Newark, N J
 GEORGE S WILLIAMS, Central Maine Power Co, Augusta, Me

Geographic Division Representatives

Canadian—R B McDUNNOUGH, Quebec Power Co, Quebec, Que
Eastern—W H HORTON, JR, West Penn Power Co, Pittsburgh, Pa
East Central—J B JOHNSON, The Ohio Public Serv Co, Elyria, Ohio
Great Lakes—EUGENE HOLCOMB, Continental Utilities Co, Alma,
 Mich
Middle West—ARTHUR HUNTINGTON, Iowa Railway & Light Co,
 Cedar Rapids, Iowa
New England—H M PARSONS, Central Mass Elect Co, Palmer, Mass
North Central—L O GORDON, Southern Minn Gas & Elect Co, Albert
 Lea, Minn
Northwest—LEWIS A McARTHUR, Pacific Power & Light Co, Port-
 land, Ore
Pacific Coast—A W CHILDS, Southern California Edison Co, Los
 Angeles, Cal
Rocky Mountain—LUKE STOREY, Home Gas & Elect Co, Greeley,
 Colo
Southeastern—E W ASHMEAD, Alabama Power Co, Birmingham, Ala

CONTENTS

	PAGE
General	1
National Farm Power Survey.....	1
Foreign Farm Power Survey.....	1
Joint Committee on the Relation of Electricity to Agriculture.....	5
Plan of Organization and Procedure for Companies Supplying Rural Electric Service....	6
Development of Farm Equipment Suitable for Electric Drive.....	11
Research Features.....	13
Rules for Supplying Rural Electric Service.....	13
Appendix A—Summary of the National Farm Power Survey.....	14
Appendix B—Rates, Rules and Regulations Applicable to Rural Service as Filed with the Railroad Commission of Wisconsin by the Northern States Power Company.....	21

RURAL ELECTRIC SERVICE COMMITTEE

GENERAL

The Rural Electric Service Committee has held three general meetings and a number of subcommittee meetings during the fiscal year. The committee has kept in close touch with the experimental work concerning rural electric service being carried on in the several states and has endeavored to assist in this work wherever it could. In previous reports statements have been made regarding the size of the farm power load. These statements were estimates. This year more reliable figures are given as the United States Department of Agriculture has completed their farm power survey.

NATIONAL FARM POWER SURVEY

During the past year the United States Department of Agriculture has made a very complete survey of the primary power now being used on the farms of the United States. Mr. C. D. Kinsman, Service Agricultural Engineer, United States Department of Agriculture, presented a summary of this survey before the eighteenth Annual Convention of the American Society of Agricultural Engineers held at Lincoln, Nebraska. This summary is brief and concise and contains so much new and valuable information that it has been included in the Appendix of this report. The complete and detailed report can be obtained from the United States Department of Agriculture. The survey shows that:

- a. The total primary power used in United States Agriculture is approximately 50,000,000 horse power.
- b. The total horse power hours developed annually in this industry is approximately 16,000,000,000.
- c. The cost of power on farms in the United States at present values is about \$3,000,000,000.
- d. By the use of this power, together with modern labor saving equipment, the American farmer is enabled to increase his production per man by at least three times over what was possible with other methods 75 years ago.
- e. An extremely close relationship exists between the amount of power and machinery used per worker and the volume of production.
- f. A large number of workers have been released from agriculture by the employment of power and machinery on the farms.

Fig. 6, 7 and 8 are valuable as basic information in our study of rural electrification. The comparison of agriculture with other industries is surprising in the nature of its disclosures. Fig. 6 points out most emphatically that:

1. Agriculture must employ more power, or
2. It must utilize what power it now employs a

greater number of hours per year, i. e., *improve its load factor.*

3. The investment per primary horse power could be reduced below that of manufacturing industries by the economic use of more power, and
4. In the addition of more power, some could profitably be employed in the "manufacture of farm products on the farm" from their own raw materials.

The horse power hour utilized per worker on the farm is, of course, affected by seasons, locations, nature of farm crops, etc. There is no question but that in a large part of the farming industry in this country some form of automatic machinery which could be made to operate during the night or at times when the average farm worker is unable to perform such work would tend to greatly increase the hours use of power on the farms.

Fig. 7 shows that only a very small portion of the total estimated primary horse power available on farms of the United States is supplied electrically at the present time. By including all individual farm lighting plants approximately 2,000,000 of the 50,000,000 horse power is electric, or four per cent of the total. By replacing steam engines and gas engines now doing belt work this amount could be increased to twelve millions of horse power, or to 24 per cent of the total.

From Fig. 8, if all of the power operations that could be performed electrically at the present time without further development work, had been electrified the energy consumption for a year in farm power alone would have been nearly five billion horse power hours, or nearly four billion kilowatt hours.

If to this is added the lighting consumption in the farm homes estimated at two billion kilowatt hours annually we get a total of six billion kilowatt hours as the amount required for lighting the farm homes and for operating the belt driven machines now used on the farms of this country. This figure does not include anything for the thirty billion man hours per year necessary to carry on our agricultural industry and some of which can be replaced by electrical machinery. Neither has any figure been included for electric cooking, refrigeration, water heating in the dairy, electric lighting in the hen house and at the feed lot and many other special applications all of which will be used in varying amounts when electricity is made available to the farms of this country.

FOREIGN FARM POWER SURVEY

The Department of Commerce through its Bureau of Foreign and Domestic Commerce has gathered information on rural electrification from nine countries and has issued special circulars through its Electrical Equipment Division, R. A. Lundquist, Chief. The first circular is dated December 6, 1924, and the

final one of the series is dated February 11, 1925. These circulars are very well written and should be referred to by those interested in further details. While it is difficult to understand some of the figures given, such as percentage of farms connected, consumption of current, etc, yet conclusions may be drawn as follows:

1. That rural electrification is no further advanced in Europe than in this country.
2. That in some countries committees are trying to promote rural electric development.
3. That in most cases the power producing companies or municipalities do not assist in rural distribution, such distribution being in most cases carried out by cooperative groups formed for this particular purpose. This method has in at least one case led to much overbuilding and produced a very burdensome condition.
4. That regardless of ownership or the method of operation, rates to rural customers are no lower nor more favorable than in this country.

Abstracts of Department of Commerce Circulars

DENMARK

Circular 295, Dec. 6, 1924. Information furnished by Acting Commercial Attaché H. Sorensen, Copenhagen.

The development of rural electrification is of comparatively recent date. During the closing years of the war and the years immediately following the Armistice, the prosperity of the Danish farmers encouraged the installation of electricity on the farm to such an extent that at present about 50 per cent of all Danish farms are electrified. Farms are probably not over 50 to 75 acres average. Distances are not very great and general conditions are favorable to electric service. With one or two exceptions, power is generated by steam or Diesel engines.

The methods of financing differ, but the state or municipal governments give no financial assistance. A large majority obtain current from central stations. Most of the distribution lines are owned by cooperative organizations made up of customers. In some cases they also own the central plants, and in some cases current is bought from city power plants, but customers have no more favorable rates in such cases. Rates are based on a fixed charge plus energy and vary somewhat according to the price of fuel—at present ranging from 8.75c to 17.5c for light and from 5.25c to 10.5c for power per kilowatt hour with different companies. The uses are for lighting, threshing, grinding feed, cutting, pumping, etc. Motors are from 5 to 30 h.p. There is almost no equipment purchased for joint use.

NEW ZEALAND

Circular 297, Dec. 8, 1924. Information furnished by Consul General Edwin N. Gunsaulus, Wellington.

The majority of farmers are financially able to employ electricity at existing rates but many already have internal combustion engines and are unwilling to change.

The government has built and is building very large water power plants to supply the entire country. Fuel costs are high and current for farm uses averages about 16c per kilowatt hour for light and 6c for heat and power.

The distribution of current is controlled by a power board elected by the taxpayers. The government advances money to the power board. The lines and transformers

are owned by the distributing authority. A guarantee is required before installation of lines.

The chief uses on the farms are for milking, hot water, lighting, heating, cooking, pumping, sheep shearing, cream separators, etc. In addition, power is used in centralized depots in fairly large quantities for freezing meat, fruit, flour milling, etc. Motors on the farms are from ¼ to 3 h.p.

The power boards assist individual farmers by advancing money to install wiring, motors, etc. The cost to individual farmers varies from \$43.00 to \$130.00 per year.

Approximately 35 per cent of the agricultural districts have electric power available.

There are about 1000 individual lighting sets on farms and about 6500 take current from power lines.

ITALY

Circular 300, Dec. 17, 1924. Information furnished by Commercial Attaché H. C. MacLean, Rome.

Where Italian agriculture is deficient it is due almost entirely to either too much or too little water. Therefore, pumping is the most important use of electricity on the farm. Plowing has been experimented with but is not generally considered successful. In one province 333 agricultural consumers use 10,000,000 kilowatt hours per year. The consumers are divided into 132 for land reclamation, 15 for irrigation, 81 for drying silk cocoons, 6 for threshing, eight for plowing, and the remainder for minor uses.

In 1921 another company in another province had 480 installations for pumping water.

Generally the power companies do not supply power direct to rural districts, the usual method is to have an intermediary distributing company, buying power in bulk and running lines out to serve the farmers.

Farmers still are skeptical as to the benefits and are usually unwilling to make the necessary investment to try out the theories. Therefore, the primary function of the distributing organization is to advance funds for lines and equipment, this expenditure being recovered over a period of time through charges against the consumers.

These distributing organizations are of a semi-mutual character. One such organization had in 1922 about 70 miles of high tension lines and 25 miles of low tension lines with 40 transformer stations and about 500 customers. There were 37 pumping outfits totaling 300 h.p., also 22 installations for other agricultural uses with about 500 h.p. and several portable pumping outfits, three portable transformer stations and motors from 15 to 60 h.p. for operating threshing machines, etc., and a complete plowing outfit operated by two 90 h.p. motors. They also own some small tracts of land intended for demonstration fields. Current is sold at same rates as in Rome.

Another large organization supplying rural service does plowing by the acre and performs other farm work, presumably by contract at a price per bushel, etc.

The Italian Government grants subsidies to bring about more extensive use of mechanical methods in agriculture to increase production. These subsidies for electrical applications to agriculture are based on size of hydro-electric plants and size and length of lines, with certain restrictions.

No provision, however, is made for subsidizing the intermediary organizations. In only a few cases have power companies taken advantage of the subsidies offered for the construction of lines.

FRANCE

Circular 301, Dec. 17, 1924. Information furnished by Assistant Trade Commissioner Wilson K. Ray, Paris.

Strong pressure has been exerted upon the French Government by agricultural interests to secure governmental

aid in loans and subsidies in extending electrical power to the rural districts.

In order to replace the man power lost to the rural districts during the war, it is thought this can best be done by installing machinery capable of increasing the productivity of those workers who remain on the farms. Also, the development of hydro-electric power would decrease importation of coal, oil and gasoline.

The larger plants now provide current for only about 6000 of the 36,000 communes and it is considered that power can be economically distributed to 20,000 additional communes having a population of about 10,000,000, practically all of which can be classed as rural.

A law passed in 1923 makes provision for granting of special loans for the extension of electrical service in France. Up to the present time it has not been suggested that the government construct and operate electric power systems which would give electric service to farms.

Farms in some districts are very small; they are larger in the northern districts and smaller in the southern. The electrified farms vary in size from 100 to 800 acres. The majority of the farmers are very prosperous, and where the size of farm warrants it, they are financially able to use current at existing rates. Rates vary from 6c to 9c per kilowatt hour.

In areas where farms are electrified it has been customary for cooperative societies to finance and operate the distribution systems, buying power in bulk and supplying it to their members. The National Office of Agricultural Credit may loan funds to such organizations.

At present, electricity is used in rural districts chiefly for lighting and such farm machinery as presses, dairy equipment and pumps, and a few threshers; field work is experimental only. Motors range from one to ten h.p. Machines are mostly belt driven. On the small number of farms electrified, the estimated consumption is from one to five kilowatt hours per day. Plowing in a few instances has been successfully tried.

The number of properties having small electric plants, either fuel burning or hydro, does not exceed 500, and the number of farms served by distribution lines is much smaller.

SWEDEN

Circular 307, Jan. 9, 1925. Information furnished by Basil D. Dohl of the Electrical Equipment Division, taken from books, pamphlets and press clippings forwarded by the Copenhagen office of the Bureau of Foreign and Domestic Commerce.

Prior to 1912 there was very little use made of electricity on the farms of Sweden, but since that time rural electrification has developed rapidly. During the World War the demand for power was greatly increased and both state and private companies enlarged their building programs, with the result that electric energy can be produced to such an extent as to make it available to the rural as well as the city population of the country.

There are about 428,000 farms in Sweden averaging about 20 acres each. Crops are limited owing to the climate and are only of local importance, except the dairying industry which is very important—57 per cent of the total area is woodland forests.

During the prosperous years the farmers were able to meet the costs of construction and installation work to electrify the farms, but during recent years they have complained of the financial burden which resulted from those charges, based on wartime construction costs.

Farm electrification was given such great impetus and many adopted it without having assurance that their farms could, even in times of low prices for equipment, bear the burden of added expenditures. Conceding that electrification will afford many advantages to the agricultural industry, it must be appreciated that there are not as yet many farms that are adapted to economic electrification. In general the farmers in Sweden have considered lighting to be the main use for energy, and have done very little

toward using it for power. At present about one-fifth of the developed electrical energy of Sweden is controlled by the state and four-fifths by private organizations. It is estimated that the government's system supplies power to about one-third of the rural areas that have electric service available.

In one territory the farmers and other smaller consumers have formed cooperative distribution societies, which purchase power from the Board of Waterfalls, then resell the energy to its members.

Capital in most cases is obtained from banks by these societies on a 10 to 25 year basis. By this method of financing the individual members are free from initial payments to the society. This is important because at the time of installation the consumer-member must make a considerable outlay for the necessary electrical equipment for his farm. This arrangement has a decided disadvantage—that of overbuilding.

The capital outlay in rural electrification previously carried out amounts to about 400,000,000 crowns; 270,000,000 crowns being invested in power stations and lines and 130,000,000 crowns in farm electrical equipment. Of the 270,000,000 crowns invested in plants and lines, 235,000,000 crowns is in plants owned by country villages. Payments of about 85,000,000 crowns have been made and the present debt is, therefore, estimated at 150,000,000 crowns. Of this debt it is generally conceded that 100,000,000 crowns may be regarded as the replacement value of the plants, leaving a remainder of 50,000,000 crowns, which represents the extra cost due to wartime construction. This must now be covered by operating profits and consequently it is felt that rural consumers will be confronted with charges heavier than they can bear.

The Distribution Associations charge a fixed fee for connection based on the number of shares held or acres of land cultivated by the members; in addition a charge is made for energy, generally from 8c to 15c per kilowatt hour for lighting and 4c to 6.5c for power. This rate is said to discourage additional new uses. An effort is being made to get the charges reduced closer to production costs, which are estimated at 1.8c per kilowatt hour for energy plus 10 to 15 per cent core losses.

The uses on the farm are principally for lighting, very little use is made for household appliances. Motors for small farm operation of $\frac{1}{2}$ to 5 h.p. are in use. Electric power has not been extensively used for plowing, although experiments have been conducted which promise successful operation. The plow was designed by a Swedish engineer. Current is supplied through an insulated cable which rolls on a drum automatically as the plow moves. Other usual farm operations are carried on.

According to Mr. Nils Edwal, C.I., Rural Electrification Expert of the Swedish Department of Agriculture, about 3,700,000 acres of arable land in Sweden have been electrified up to January, 1923, which is roughly 40 per cent of the total arable land in the country.

GREAT BRITAIN

Circular 309, Jan. 17, 1923. Information furnished by Hugh D. Butler, Trade Commissioner, London.

The application of electricity to agriculture in Great Britain is not extensive, although there are examples of electrically operated farms in Scotland, Hereford, and Sussex. These are, however, large estates that either maintain individual generating plants or buy their power from nearby towns. In South Wales and in the southwestern part of England several farmers use electricity to a varying extent for both lighting and power purposes. There are also in some parts several small water power plants used to generate electricity for lighting purposes only.

Most of the farms are operated by renters and it is not expected that they would purchase the necessary equipment, neither will the owner undertake this added expense. The distribution systems are usually built with under-

ground cables and the cost of extending lines to scattered consumers is so high as to make the necessary rates unable to compete with other forms of power.

There is no movement by the government toward the development of national power systems, although there is a commission to formulate plans for the gradual building up of large capacity power stations to replace the small ones now in operation. In this development the government plans to help the farmer.

There has been so little development in the general use of electricity in rural districts that no table of rates can be given, but it is reported that some power has been furnished for as little as 2c per kilowatt hour with light at 12c to 16c per kilowatt hour. It is believed that installation costs rather than rates have been the real deterrent in the use of electricity in agriculture. While the development of electric service in rural districts through power lines has been limited, it is believed that there are between 15,000 and 20,000 individual home lighting plants used mostly for lighting on country estates. There are no co-operative distribution societies for financing the distribution of electricity in specific areas.

The very interesting experimental applications of electricity to various farm operations carried on by Mr. R. B. Matthews on his 600 acre farm at Greater Felcourt has been previously reported on by this committee. A considerable amount of experimental work in electric plowing has been done but no satisfactory solution has been reached.

THE NETHERLANDS

Circular 308, dated Jan. 10, 1925. Information furnished by Philip E. McKenney, Secretary to Commercial Attaché, The Hague, Netherlands.

The use of electricity in the agricultural industry in The Netherlands has not passed experimental stage, and its uses are limited principally to a small number of threshing machines. No system of overhead distribution has as yet been adopted; as the farms are well scattered there is very little use made of electricity. The systems in this country are both municipal and provincial power systems. The former supply current to the surrounding districts while the latter supply an entire province from one central station owned by a company or association. The provincial authority being the sole or chief shareholder.

There are no so-called electrified farm sections. Farms are small, averaging 25 to 50 acres. There is no water power development in Holland. Power is principally generated by steam. In 1921 there was a total of 488 electric power plants and distributing stations in the country. Plans are being considered for building large power plants by the state, including a distribution by network of high tension lines over the whole country. The use of electricity is stated to be as follows: Power for industries, 60 per cent; light, 25 per cent; traction, 10 per cent; drainage pumping, 4 per cent; agriculture, 1 per cent. Rates for power vary from 8c to 11c in cities having population of 100,000, to 8c to 25c in cities from 10,000 to 20,000.

There are no cooperative organizations for the purpose of financing and operating distribution systems in small areas. The farms which now use electricity receive the current from underground cables; there being at present no overhead distribution to individual consumers. The farm consumers are usually close to main thoroughfares and the same method is used by the power companies in calculating installation costs for both rural and city consumers. Under the present system the expense for the smaller farmer who may be a considerable distance from a power line would be prohibitive, but if the plan of overhead distribution is carried out he will be afforded the advantages of electricity.

The principal uses for current besides lighting are for operation of a small number of threshing machines and cutting machines, also pumps for drainage purposes. Motors in use are in general from 1 to 5 h.p. The annual cost of electricity to the farmer depends upon the proximity of the farmhouse to the power line and upon the

extent to which current is used. However, as the city conditions usually apply to the average farmer his annual cost may be estimated roughly at \$23.00.

GERMANY

Circular 311, Jan. 29, 1925. Information furnished by Assistant Trade Commissioner Margaret Goldsmith, Berlin, Germany.

Note: In considering the development of the use of electricity in agriculture in Germany one should bear in mind that this as many other economic movements has been brought to a temporary standstill by current financial conditions.

The use of electricity on the farm does not predominate in any particular farm area and there is no purely defined electrified area in the entire republic. This is probably due to the fact that many farms are not in close proximity to sources of power supply. Approximately 90 per cent of the power used on estates and farms is generated by fuel, but water power is used for this purpose in south Germany, where it is readily available.

The German Government has not participated to any great extent in the development of power resources nor is it at present installing new power plants which will afford service to rural districts. The ownership of electric power plants is equally divided between the government and private interests. Some of the largest plants, however, are owned jointly by the government and by private interests.

It is estimated that the average cost per kilowatt hour is approximately 10c to 12c, an increase of 10 per cent to 20 per cent above the pre-war rate. These rates are the same for all users of electricity, farm consumers being given no price concessions over city users.

There are numerous "power cooperatives" in Germany that buy electric energy in bulk and distribute it to the members of the association within the area served by them. The government does not advance money to these distributing societies, but before the war it aided them through giving indirect subsidies in the form of cheaper credit than was extended to other organizations having equally as good or better financial standing.

Ordinarily the electricity supply company owns all of the high tension lines and thus pays the construction expenses to the transformer station. The low tension lines beginning at this point and running to the buildings of the individual consumer are almost entirely financed by the distribution organizations. The transformer station is usually located in the town around which the farms are situated and the distance to the various farms and estates from this station—at which point the distributing company takes over the expense—varies greatly. When large estates are the only consumers of electricity within a radius of several miles the estate owner pays the transformer cost and also finances the erection of the low tension line. In all other cases the power cooperative organizations pay the transformer costs.

Electric power is commonly used for threshing, preparing fodder, milking, butter making and distilling, but is used only to a very small extent for plowing. It is also used for household purposes—lighting, cooking, sewing and various other labor saving devices. Motors used range from 1½ down to as small as ¼ h.p. It is practically impossible to state the average expense of the average farmer for electricity. It is estimated, however, that approximately 8 to 10 kw-hr. per acre of land in the electrified area are needed. At an average rate of from 10c to 12c per kw-hr. the approximate average cost for farms of various sizes can be estimated.

Electric plowing is not done on the commercial or private basis. However, steam plowing is well developed. Very little electrical equipment is purchased by groups of farmers, although some communities have purchased jointly large motor units for operating threshing machines. Electric service is quite generally available throughout Germany and it is estimated that at the present time

about 66 per cent of the farmers whose farms are in an electrified area use electricity.

FINLAND

Circular 323, Feb. 11, 1925. Information furnished by Vice Consul Frank P. S. Glassey, Helsingfors, Finland.

The electrified section of Finland is rather sharply defined, occupying the southern and southeastern parts of the country, where the largest and richest farms are situated. It is not possible to state accurately the average size of farms in the electrified districts. Approximately 75 per cent of the farms in Finland have an area of less than 25 acres, and the total of 250,000 farms. A typical Finnish farm usually consists of a compact group of buildings in close proximity to the fields. Most farmers in the districts already electrified are financially able to make use of electricity at existing rates.

The power used on farms is usually generated from water power stations, which predominate, although there are many fuel burning plants in operation. Formerly most of the electrified rural communities received their power from the electric power plants in the towns or from the central power stations of the industrial establishments. Recently, however, many new power stations have been constructed. The government is at present constructing a large water power plant, but the power generated will be supplied principally to industries and railroads. It is estimated that only about 5 per cent or 10 per cent of the total power will be available for agricultural purposes. The large power stations that are operated by steam use wood as fuel.

Cooperation has been the determining factor in influencing the electrification of the rural districts of Finland. These cooperative companies or associations supply current only to those farmers who are stockholders. The amount of stock which each farmer must subscribe is determined by the number of lamps and the horse power he will use. When an industrial or community electric power station is situated near the district to be electrified the power is usually transmitted in bulk from that station to the local company constructing only the distribution network. The government has not yet thus far given either direct or indirect assistance to electrification projects in the rural districts, but a petition has recently been filed asking for a government loan of 10,000,000 marks to be used for this purpose. The electric company generally pays for running the power lines up to the main farm buildings and furnishes the transformer.

Electricity is used on Finnish farms principally for lighting purposes. Power is employed for threshing, grinding flour and pumping water, but not for plowing. Motors are usually $7\frac{1}{2}$ to 15 h.p. Equipment is seldom purchased by a group of farmers for their use in common, although at times two or three farmers will purchase a motor which is used jointly.

There are no available statistics which show the percentage of the agricultural area in which electricity is available to farmers. Of a total of 500 districts 200 have been electrified. This does not, however, represent quite 40 per cent of the agricultural area. It is estimated that at least 1500 farms are now supplied with electricity, practically all receive current from electric companies. Farms which use electricity are usually more progressive than those on which electric power is not employed.

WORK OF JOINT COMMITTEE ON THE RELATION OF ELECTRICITY TO AGRICULTURE

During the past year the membership of the Committee on the Relation of Electricity to Agriculture has been increased by adding a representative from the National Grange and two representatives from

the manufacturers of major electrical equipment who came in through the National Electric Light Association.

State Committees on the Relation of Electricity to Agriculture have been organized in 15 states making an increase of eight since last year's report. The states are as follows: Alabama, California, South Dakota, Illinois, Indiana, Iowa, Kansas, Minnesota, New Hampshire, New York, Ohio, Oregon, Virginia, Washington and Wisconsin.

In every one of these states, except New York, investigation work is being conducted, or definite plans are being formulated to get such work under way. At the time this report was prepared no attempt had been made to summarize the results from these state investigations. A meeting at which all project leaders will present complete reports from the beginning of each project up to May 1, 1925, will be held at Madison, Wisconsin, the latter part of June.

The National Farm Power Survey conducted by the Division of Rural Engineering, U. S. Department of Agriculture, has been completed and is ready for the printer. A partial summary of this is presented elsewhere in this report.

The foreign survey on the rural uses of electricity conducted by the Electrical Division of the U. S. Department of Commerce has been completed and reports issued. A summary of these reports is presented elsewhere.

A review of investigation work on the application of Electricity to Agriculture was prepared by the office of Experiment Stations, U. S. Department of Agriculture and published as Volume I, No. 2 of the Committee on the Relation of Electricity to Agriculture Bulletin.

There are four outstanding developments as a result of this work during the past year.

1. Investigation work has been established on a comprehensive basis with wide geographic distribution. Every important type of agriculture is represented to a greater or less degree. As a result of this, confidence is increasing that this method of attack is the most logical one yet presented.
2. We are finding what the specific problems are with the natural result that the correct ways to proceed are becoming more evident each day. Discussion of a general character is rapidly giving way to a discussion of plans of action along well directed lines. Order is emerging from chaos.
3. A positive morale is rapidly being developed. The men who are working on this problem are beginning to express conviction that "It can be done." The importance of a positive attitude of mind in a problem of this character cannot be overemphasized.
5. There is a greatly improved understanding between the Agricultural and the Electric Light and Power Industries. Agricultural leaders are beginning to understand what is

involved in electric light and power service, and are passing this information along in many ways to the rank and file. On the other hand, the leaders in our industry are coming to realize that a definite, constructive policy looking towards rural electrification can be established.

A PLAN OF ORGANIZATION AND PROCEDURE FOR COMPANIES SUPPLYING RURAL ELECTRIC SERVICE

The characteristics of rural electric service are so new to the electrical industry that an outline of procedure to be followed by public utilities will help in the development of the business along logical lines and in pointing out costly errors which might lead to unsatisfactory results.

The committee believes that rural electric service business when properly developed can be made beneficial to both the utility and the customer, and that the principal problem lies in the development of a plan which will lead to the full utilization of electricity on the farm. To this end rates for service should be so selected and policies so developed that extensive use of electricity by the farmer will be encouraged.

We believe that rural electric service should be considered as a separate class of service rendered by the electric utility. Its characteristics and possibilities are such that it differs very materially from residential lighting business, commercial lighting business or industrial power business. We believe the recognition of this point is essential for its successful and proper development and that any attempt to identify it with other existing forms of electric utility business will impede its progress and tend to render it a burden rather than a sound business enterprise to the company furnishing it.

We also believe that the rural service problem is one which calls for the education of both the utility furnishing it and the customer receiving it. We believe that the attitude of those utilities, which consider rural service a burden, is to be deplored and that this attitude is the result of a lack of understanding on the part of those utilities as to its possibilities. We believe that the attitude of the customer, who is prone to regard it only as a source of convenience to be used largely for lighting purposes, is likewise deplorable and, that investigation by both parties will result in clarifying the situation and, in most cases, to a conversion of both parties to the fact that their problem is a common one which is capable of satisfactory solution.

We believe that a utility entering upon a rural service program must realize that its ultimate development involves not service to a group of isolated farms, but service to an industry, the biggest single industry in the United States. Along with this realization must come a conviction that in order to care for the needs of this field successfully it is necessary that *real* service be rendered. The realization of the ideal of completely serving this great

industry may not come for many years, and the attainment of satisfactory results will be determined very largely by the adequacy of plans made now for its conduct.

One of the first steps which should be taken by a utility desiring to initiate a sound rural service policy is the development of a rural service organization.

The Development of a Rural Service Organization

The rendering of rural electric service involves problems of both an electrical and an agricultural character. The electrical development presents no problems which will not yield to systematic study by talent already employed by the electric light and power industry. The agricultural phase of the question, however, presents many problems with which the electric industry is entirely unfamiliar. For this reason we believe that a utility entering upon a rural electric service development program should secure the services of a man trained along agricultural lines and with an agricultural viewpoint. Such a man should be sympathetic towards agriculture and able to talk the farmers' language. This is particularly necessary since the development of rural service upon a sound basis depends so largely upon the proper development of an agricultural load and requires the services and experience of one familiar with agricultural problems. We, therefore, recommend the employment of such a man by utilities of sufficient size to warrant it, and in the case of small utilities, we recommend the development of one in its existing organization to the greatest degree possible along agricultural lines and the assignment to him of all problems involved with rural service.

Territorial Survey

In order that the development of rural service may be made in a logical manner, it is believed that it is necessary to make a systematic survey of the territory to be served. Such a survey should embody a mapping of the territory by suitable subdivisions such as townships, such maps should show roads, telephone lines, electric light and power lines, farm locations, the farming characteristics of the territory, topography of the territory and other elements which will be essential in developing the proper locations of lines and load possibilities. Under usual conditions the territory should be divided into service districts, the boundaries of each district being determined by the farming characteristics, topography and other similar conditions. It will usually be found in the case of a utility serving an extensive territory, certain portions will comprise profitable farming communities with extensive electrical requirements while other portions of the territory may comprise land which is barren and unprofitable. The boundaries of service districts should be determined by these conditions as well as by natural topographical conditions. Distances from sources of power may determine district

boundaries in many cases. Another factor is the prevalence of community organizations, since the dissemination of information and a uniformity of attitude might be expected to prevail in territories covered by such organizations. Still another factor of influence is the existence of other electrical loads and the routes of transmission line. Each district should be developed as a unit and its boundaries should be so determined that the development will be most economical from a construction standpoint and most productive from a load standpoint, having in mind those psychological and other factors which tend to determine the boundaries within which a community of interest exists.

Surveys need not necessarily be elaborate or expensive, and they may frequently be based on already existing maps. Among the base maps that may be easily secured for extensive areas of the country are:

Topographic sheets of the United States Geological Survey, Department of Interior.

Soil Survey sheets of the Bureau of Soils, Department of Agriculture.

Rural Route Maps of the Post Office Department.

Progressive Military Map of the United States, Engineers, War Department.

Local Maps.

County Atlas.

Most of the government maps listed above are on the scale of 1 inch to a mile and if not, may be reduced or enlarged photographically. Inquiries for the maps described above and their price should be sent direct to the bureaus named, at Washington, D. C.

Having determined such district boundaries, the problem of the layout of the main feeder lines will be one in which engineering consultation is essential. It is not necessary that a comprehensive scheme of rural lines should be laid out until the requirements of electric service have been determined by trial, but before any construction is undertaken, districts should be determined and general feeder routes selected so that when the requirement later develops, extensive reconstruction may not be necessary. Again it is necessary that the laying out of such feeder routes should not consider service only to such individuals as may be immediate prospects but should consider the ultimate service of the entire district. The problem is not the rendering of service to a farmer or group of farmers but the rendering of service to the agricultural industry.

In the layout of a system as above described, it is important that an analysis be made of the prospective load which may be developed. Experience indicates that various types of farms are capable of utilizing electricity to widely varying degrees and under widely varying conditions. Information relative to the requirements of farms of different types is being secured by means of experimental rural lines throughout the whole country and data secured from such experimental lines will prove most essential in the laying out of a general scheme of service,

particularly in that it will indicate the extent to which various kinds of farms are capable of utilizing central station service. As a guide we submit the following general classification of rural customers in which uses for electricity may widely differ:

- (a) Dairy Farms
- (b) Fruit Farms
- (c) Poultry Farms
- (d) Stock Farms
- (e) Grain Farms
- (f) Cotton Plantations
- (g) Forage Farms
- (h) Truck Gardens
- (i) Country Estates
- (j) Community Enterprises

In addition to these general types there are innumerable specialized types of farms such as those engaged primarily in the raising of sugar beets, peas, potatoes and other farm and market products.

It must be recognized that the uses of electricity at the present time are limited, aside from lighting purposes, to household uses and stationary power. It may be that later developments will indicate its applications to field power such as plowing, cultivating, and harvesting but present developments have not been sufficient to indicate whether such uses will be of ultimate importance. Household uses will include lighting, washing, ironing, cooking, refrigeration and the usual household applications. Stationary power uses will include pumping for irrigation, drainage, domestic water supply, grinding, milking, conveying, threshing, etc.

For specific information as to the possibilities of such uses in various sections of the country, we refer to reports of the Department of Agriculture which have covered the situation with reasonable thoroughness, and the forthcoming reports of this department based upon investigations at present in progress. We also refer again to results obtained upon experimental electric lines at present in progress of construction and operation in various states which it is anticipated will be presented in current and forthcoming issues of bulletins by the Committee on the Relation of Electricity to Agriculture. We wish to refer to the possibilities of electric pumping for household and farmstead purposes with particular emphasis. This is a character of load which is capable of yielding an excellent load factor and which proves of immense value upon most types of farms. The development of farm machinery for electrical applications is covered elsewhere in this committee report.

After securing an analysis of possible loads and the design of suitable feeder circuits for caring for such loads, the problem of rates under which the service shall be rendered is the most important issue.

Rate Forms and Elements

The committee realizes that there are a great many different forms of rates and rules in existence for supplying Rural Electric Service. Some of these practices have been fairly well established in

some districts and are giving satisfactory results. It is not the intent of this committee to recommend a change in any present practice where such practice is giving satisfaction. Local economic and geographic conditions are so different in various sections that general rules cannot be laid down to apply in all cases. The committee, however, recommends that wherever no satisfactory rules are in force that serious consideration should be given to the following discussion:

The committee believes that a rate for rural electric service should not be encumbered by a close adherence to any existing forms of rates suitable for other lighting or power purposes. Rural service is as distinct from either usual lighting or power service as lighting and power services are distinct from each other. This distinction is not only one of load characteristics and investment costs, but there is also a marked distinction in customer psychology. The committee earnestly recommends, therefore, that rural service be considered as presenting an entirely separate and distinct rate problem and that a rate be developed from the ground up rather than built upon any substructure of existing rates and conditions. In the committee's opinion a rate system need not be uniform for the entire territory served by a company because different types of farms in different parts of the territory may merit separate consideration and because conditions of energy production and distribution may vary considerably. The committee recommends that a uniform rate (giving consideration to locations and requirements of individual customers) be applied to one rate district. This rate should be such that it will be just and equitable to all customers within the district. Rates for each district should coordinate with rates for other districts and all should be developed along similar lines.

The development of a rate for rural service involves two features which are equally important. The first feature gives consideration to economic conditions. The second feature gives consideration to the psychological conditions. It is important that a rate be sound economically and also that it be of such character that it will satisfactorily meet the customers' agricultural conditions and appeal to them in such a way that it will lead to the largest use of electric service in farm operations. The economic considerations of the rate are capable of thorough analytical study. The rate structure necessary to meet the psychological conditions must be determined from a study of the farmer's viewpoint of the situation and his attitude toward the service. These are entirely the result of experiment and experience.

Considering first the economic features we must recognize the fact that the rural line represents a greater investment per customer than does the urban line. For this reason the rate should naturally take the form of a service charge which will give a consideration to the fixed charges upon the investment varying with his location, the transformer core losses, additional costs of maintenance, etc. In addition to this service charge the rate

should embody a charge for energy which will be dependent upon the kilowatt hours consumed as determined by usual watt-hour meter readings. The amount of the service charge should be determined by careful study and should be adequate to protect the utility from loss regardless of the energy consumed. The energy charge should be sufficient per kilowatt hour to cover the usual operating and maintenance items and may be either at a straight rate per kilowatt hour or a rate under which the first portion of the consumption will be at a higher rate with lower rates per kilowatt hour following for more extended use. The amounts of the blocks of such a rate are largely a matter for local determination. Some utilities may prefer to make the initial blocks to cover average lighting requirements upon the theory that such requirements will occur at times of peak plant and line loads.

Going somewhat more into detail, the service charge should embody the following elements: First, the meter charge determined by meter investment, cost of reading, billing and customer book-keeping. Second, the service line charge dependent upon the distance of the load from the distribution line. (If desired this may be based upon an average or determined individually.) Third, a transformer charge dependent upon the size of the transformer provided for the customer's service and giving consideration to transformer core losses necessarily involved. Fourth, the distribution line charge dependent upon the extent and cost of the distribution line necessary for serving a district or group of farmers, and giving consideration to the relative demand of the individual farmer, usually estimated instead of measured. Fifth, a system charge, determined upon the basis of the customer's estimated demand, to care for the fixed costs and maintenance costs of the central station, the transmission system and substation from which the rural line receives its service.

The features of the rate from a psychological viewpoint as above stated, must be determined by experience. The committee, after a thorough analysis and study of the situation after extended discussions with representatives of agricultural interests and after experience with individual situations, recommends that the service charge be made to include as many of the fixed cost elements as is reasonable and that the energy charge be made as low per kilowatt hour as is practicable for the reason that the problem of rural service is essentially one of securing as complete a utilization and as broad an application of electricity as possible. Such a utilization and application will secure for the utility a more favorable load and for the farmer a cheaper rate per kilowatt hour. It will bring about a more satisfactory development of the business as a whole. By means of a low energy charge the application of the service to additional uses will involve proportionately small increases in the bill. We believe that this feature of the rate structure is of prime importance to the successful development of the business.

We believe it is essential that the rate be as simple as possible and that the energy portion of the rate involve comparatively few blocks or steps. Many utilities have deemed it advisable to sell all energy at the same rate but we believe this question is a matter for individual determination.

To those companies who adopt this form of rate, we recommend that the rate provide no minimum bill in its energy portion. The customer, of course, should pay the service charge whether energy is used or not. This service charge fully and completely fulfills the requirements usually imposed by a minimum billing.

Having made recommendations of the character and form of rate, there remains to be discussed the other features of the plan.

A feature upon which a wide divergence of opinion has existed is the means by which the construction of rural lines shall be financed. The average rural electric loads have been so small and the load development so uncertain that utilities have hesitated to invest large amounts of capital in rural lines. As a result practices have differed. Some utilities have financed the lines, others have partially financed them and still others have required that all the financing be done by the customers. The determination of a method of financing depends largely upon the local financial, economic and operating conditions both of the farming community to be served and of the utility which is to supply the service. However, in such cases

Where local conditions permit, and

Where a rate form is adopted similar or equivalent to the type suggested in this report, and

Where economic considerations, such as character of the district to be served and estimated load justify, from the viewpoint of both the farmer and the utility, the building and operation of such line, and

Where the farmers to be served understand the necessity of an adequate use of the electric service by them and evidence this by investing in equipment exclusive of wiring for the utilization of electrical energy, an amount at least equal to the average amount per customer invested in rural lines under consideration

the committee recommends that the utility should finance the rural line.

Inasmuch as the success of rural electric development to both the farmer and the utility depends so largely on a full use of the electric service by the farmer for all practical applications, it is very important that the utility make a continuous effort to increase the intelligent use of electricity on the farm.

We wish to call attention to the fact that if the average farmer is required to finance the line he may then be unable to purchase utilization equipment for some time, thus retarding the development of the business.

It is, of course, assumed that if the farmer is to finance the line, he is to be relieved of interest charges upon the investment in the line and in case he assumes the responsibility for its replacement, of depreciation charges, upon it. On the other hand, if the utility finances the line and assumes responsibility for its replacement when worn out, it is to be expected that the rate charged will include items of interest and depreciation which will usually appear as an element of the service charge if such a charge is in effect.

We wish to urge the necessity of a careful selection of apparatus placed upon rural lines in order that adequate and satisfactory service to the farmer may be assured both from the standpoint of voltage regulation and from the standpoint of the satisfaction which he will secure from the operation of the equipment. The utility should keep itself well informed as to the state of development of all types of electrical agricultural equipment that might be used in the territory it serves, and should be able to advise farmers as to their needs. This will go far toward preventing the utility from having undesirable equipment connected to its lines and enable it to suggest motors of proper size and type.

The proper term for the contract in years is subject to considerable variance of opinion. The committee recommends a contract over a moderate period of perhaps from five to ten years. This contract should be, however, for a sufficient period to enable the farmer to become thoroughly familiar with the equipment and give him an opportunity to purchase equipment which may be used advantageously. We believe the next few years will show such a rapid development of farm service that it will prove not only convenient but necessary to his farm operations, and that its discontinuance need not be feared.

The practical application of rural service has indicated a situation in which farmers may be desirous of having opportunities for securing the service at a later date even though at the time of the construction of the line and the institution of service to his neighbor, he may be unwilling to contract for service himself. This suggests the desirability of a provision in the contract whereby a customer may pay his proper proportion of the distribution line charge necessary to secure the construction of the line past his premises, with the idea that later as desired he may receive the service. It is suggested that the contract provide that the service may be discontinued before its expiration provided the customer continues to pay his proper proportion of the service charge. This provision would cover the condition in which a customer might move away.

In connection with the entire contract, as is the case of the rate structure, we wish to recommend the feature of simplicity. We believe that each situation should be thoroughly analyzed from an economic standpoint and its costs carefully estimated, but we believe it is neither necessary nor desirable to state in the rate and the contract all of the various details which go to make up these costs.

To do so would be confusing to the farmer who is not familiar with electric utility operation.

Methods and Types of Construction

The Overhead Systems Committee of the National Electric Light Association has presented in its reports, recommended specifications of construction for rural lines. These recommendations will be found in reports as follows:

Page 732 of the 1921 Proceedings
Page 1164 of the 1922 Proceedings
Page 766 of the 1923 Proceedings
Page 1556 of the 1924 Proceedings

In designing the line consideration should be given to the installation of equipment which will insure a high grade of service to the farmer. The rendering of service which is inadequate will only result in the absolute failure of the project. We cannot urge too strongly adequate consideration of this fact. This is not based upon opinions but is founded upon observation of actual conditions. A failure to recognize this fact will vitiate the best efforts made toward the development of the farm load and upon this development rests the whole success of the undertaking. In case the construction is put in by the customers it should be subject to the specifications and inspection of the company. It is recommended that all material used upon the rural line be the company's standard material so as to facilitate maintenance and replacements. It is recommended that transformer locations be chosen as close as possible to the load center on the farm and that efforts to serve too large a number of farmers from one transformer be avoided as the tendency will be toward increases of load which may easily develop a poor grade of service. It is also recommended that the lines be designed for the ultimate voltages and loads thus obviating the necessity of subsequent rebuilding at unnecessary expense and inconvenience.

Farm Wiring

It is desirable that, so far as possible, the utility furnishing the service shall assist in planning the wiring and that adequate provision be made so that additional uses of the service may not be made unduly difficult or impossible. With the development of rural service there will be a tendency toward the contracting of wiring jobs, with the result that the work will be placed upon a price basis, and the farmer being entirely unfamiliar with wiring problems, will secure an installation which suits neither his convenience nor his needs. Farm house wiring should be comprehensive. It should consider the possible use of electric cooking and electric refrigeration. Convenience outlets should be placed with all care and consideration which is given in the case of an urban customer. The success of the rural electric enterprise will be largely dependent upon the satisfaction which the farmer receives from the service. For this reason every effort should be

made to see that switches are installed at proper locations, that fixtures are purchased which give effective and pleasing results, and that the illumination is adequate. The farmer is entitled to the same degree of service and consideration which his urban brother expects and demands, and the farmer's wife is entitled to the same relief from the drudgery of household tasks that her urban sister has achieved. In the wiring of farm buildings adequate switching equipment should be installed so that illumination may be limited to the points at which it is necessary, thus conserving electricity and promoting convenience. On the other hand, wiring schemes should not be extravagantly laid out but should be designed from the standpoint of utility, economy and convenience. It is suggested that one of the best means of securing the desired results will be to closely supervise and direct the initial installations which will then serve as examples for later installations, since particularly in rural communities the advantages received by one customer will be quickly passed on to the other. It is suggested that in the wiring of barns, particularly dairy barns, care be taken to protect the wiring from fumes which may destroy its insulation and create hazardous conditions and unsatisfactory operation.

Relations with the Customers

The committee's experience indicates that rural customers, individually and through their organizations, are anxious to cooperate with the electric utilities in an effort to secure an adequate supply of electricity for the service to agriculture. To any utility undertaking a rural service program we recommend that every effort be made to cooperate with the farm organizations. It is essential that meetings be held with such organizations and that personal contacts be established so that the questions which will naturally arise, may be met and answered, and the farmer, individually and as a class, may have a thorough understanding of the problems and the methods by which they are being solved. We urge that the utility thoroughly familiarize itself with the results being obtained upon rural experimental lines in various sections of the country and that these results be passed on to the farmers. Such an attitude will result, first in securing an appreciation by the farmer of the nature of the utility problems, and also in the more complete utilization of electric service by the farmer which your committee believes is one factor which will contribute most largely toward the satisfactory solution of the entire rural service problem.

Every effort should be made to educate the farmer to the fact that the use of small motors over long hours is preferable to the use of large motors over shorter periods. It is essential, after service has been instituted, that a frequent and regular contact be maintained with the customer. This is more necessary in the case of rural service than in any other class of service because the application of electricity to agriculture is a new field in which new developments are constantly taking place and will

continue to take place for many years. If the customer feels that the utility is up-to-date in its knowledge of his problems, his efforts at cooperation will be greatly increased.

DEVELOPMENT OF FARM EQUIPMENT SUITABLE FOR ELECTRIC DRIVE

Two definite steps have been taken during the past year in the development of farm equipment suitable for the electric drive. These steps may be designated as follows:

1. Experimental lines operating under the auspices of state committees have developed so that we know what many of these equipment problems are.
2. These problems have been brought directly to the attention of the manufacturers of motors and the manufacturers of farm equipment. There is reason to believe that both these industries recognize that there is work for them to do and will proceed accordingly.

Directors of these experimental projects which are in actual operation meanwhile have shown much ingenuity and some inventive genius in partially or wholly mastering problems as they develop, and as a result there is today a vast amount of electric equipment in operation on the farms which form the basis of these respective experimental enterprises.

Household Equipment

Investigation of the household reveals:

1. That electrically driven labor saving devices are even more of a necessity in the farm home than in the city home.
2. That while similar equipment is desirable, the conditions under which it will be operated are somewhat different.

There are many facts to support the contention that labor saving equipment in the farm home is more necessary. To begin with there probably are more people in the average farm home, this due either to larger families or to the presence of hired hands, or both. The commercial laundry is available to the city housewife, and used to a greater or less extent depending upon circumstances. In the country, laundry work is generally done in the home.

Likewise the city bakery is usually very convenient to the city housewife, while the people in the country must depend much more on home baking.

The conditions of operation in the country also will be found to vary from conditions in the city. The city housewife can order a washing machine by telephone, and have the machine installed in the laundry. It can't be done that way on the farm. In the first place, there frequently is no laundry. A suitable place must be found for the washing

machine. In the second place in the majority of cases, there is no running water. A pump motor must be installed and a pipe line extended to the house. Next comes the problem of heating that water. A number of different varieties of electric water heaters are now in operation on experimental lines and definite comparative figures soon will be available.

The electric range in the country home also presents a problem far different from the city. In many cases the wood or coal range is relied on to cook the family meals, to heat the kitchen in winter and to keep a large supply of water hot at all times, all of which presents problems for the electric range. Some farmers are utilizing electric ranges during the summer months only. Others are installing furnaces which answers the problem of heating the kitchen and the hot water problem also during the winter months. Some range manufacturers are making electric ranges with auxiliary wood and coal burners. Data are being obtained on all of these installations.

There also is developing a problem relating to the size of oven. The farm woman bakes bread once or twice a week, and when she does, wants to bake a lot of it. The oven big enough for city service may not be adequate for the farm house.

There are other farm conditions relating to electrically driven household equipment which are radically different and many of them involve a proper water system. Only a small percentage of farm homes, at present, can boast hot and cold running water. Running water in the home both hot and cold concern not only the laundry work but the cooking, bathroom equipment, and much else and proper water facilities can be counted on as one of the great advantages which electricity will bring to the farm.

Farm Equipment

On many of the investigation projects today, the lack of farm equipment designed to use the maximum possibilities of the electric drive, has become the limiting factor in the development of this work. There are some notable exceptions to this such as the cream separator, milking machine, and water pumps, but on the whole, we are confronted with equipment which has been designed for prime movers having far different characteristics than the electric motor.

As a result of this experience, the farm equipment problems may be divided into two general classes: (1) What are the most practical ways of adapting electric drive to present farm equipment? (2) What changes are desirable in order that the farmer may be able to secure maximum results from the electric drive?

There is a large amount of equipment on farms now, and more is being sold all the time, which the farmer will not want to discard for a number of years. It is felt desirable that some means be developed whereby this equipment can be operated by electric drive. As most of this equipment has been designed and built for prime movers with from 300

to 650 revolutions per minute, it would appear that at least during this development period, it is desirable to provide for some speed changing device which would give the variety necessary to meet the situation.

In only a few cases has a thoroughgoing attempt been made to adapt the electric drive to farm machinery or farm machinery to the electric drive. It appears that before maximum results can be expected, there should be a complete overhauling of this problem from the ground up, analyzing and classifying each operation with a view to developing that which will be particularly adapted to the requirements of efficient, satisfactory and economical electric service on the farm. These operations as they exist today, might be classified as follows: (1) Those adapted to the individual drive, (2) those which are adapted to a fractional horse-power portable motor, (3) those which can be performed by a portable motor of five horse-power or less, (4) those which require a motor of ten horse-power or over.

From the above classification, it is evident that a great variety of operations and conditions are to be met and that the farmer wishes to do this with as small an outlay as is consistent with the securing of good equipment from the standpoint of economical and efficient electric service. A low demand with as good a load factor as possible is desirable. Operations which require fractional horse-power motors and which come at regular intervals and even some operations requiring larger motors which may come at regular intervals, appear to be adapted to the individual drive.

The efficient, moderately priced electric motor is a high speed machine, while most farm implements are built to run at low and variable speeds. When the farmer attempts to apply electric power to farm implements, generally he finds it a very difficult job, and one which he usually abandons before accomplishing anything.

Following are the problems which the experimental lines have developed:

1. Drive pulleys on present farm machines are not made to run at the same belt speeds for different machines and therefore any motor with a given size pulley will not run the different machines at the proper speeds.
2. Pulleys of sufficient size to give low speeds to farm equipment cannot be used because in some instances they would have to be as large as eight feet in diameter which naturally would preclude their attachment to farm implements.
3. The use of gears at the motor to secure low speeds introduces many new problems.
4. In belt drive, the use of any speed reduction devices at the motor would require the use of slow speed belts to the farm machine and such belts would need to be wide, driven under high tension, would have short-life and are inefficient.

5. Certain types of farm implements such as the threshing machine should be run at two or three different speeds according to the type of grain that it is handling.

Countershafts, speed jacks, and back-gearred motors are being used on the various experimental lines and are today driving various types of farm implements but are crude and not satisfactory, for the reasons above stated. In addition thereto different size pulleys are being used on the motors but experience emphasizes that frequent changing of pulleys will soon render the shaft and pulley unusable.

It appears, therefore, very desirable to have a uniform belt speed adopted by manufacturers of electric motors and farm equipment. It may be necessary to adopt a belt speed of 3500 feet per minute or more for the larger power machinery while a belt speed of 1000 feet per minute or less may be adopted for speeds where small fractional h.p. motors may be used. If a lower belt speed for fractional h.p. motors is adopted, it might be possible to have a 5 h.p. motor shaft equipped with a pulley on one end to give the high standard belt speed for transmitting most of its power while the other end of the motor shaft might be equipped with a reduction gear, or small pulley so as to give the lower standard belt speed to use for small power requirements driving on farms where a small utility motor was not purchased.

If standard belt speeds can be adopted and farm machinery equipped to be driven with belts at these speeds then the application of electricity to agriculture will be advanced very materially and very rapidly.

On one of the experimental lines the portable general use motor is being connected to the farm equipment through an automobile transmission and a short shaft containing two universal joints. This machine has not been tried out sufficiently to justify itself but this method of applying power deserves and is receiving careful study and attention. The losses introduced need careful analysis. It may be pointed out again for the sake of emphasis that mechanical efficiency is a prime requisite in the application of electric motor to farm machinery.

The foregoing recital of difficulties encountered in applying this new motive power to agriculture does not mean that the project directors in charge of the various experimental lines have been content to wait for the way to be made easier for them. On the contrary, their initiative and inventive ability has enabled them to apply electric power even under the adverse existing conditions. The result is that while many applications are crude and primitive, nevertheless electricity is today driving a countless number of different types of equipment on the experimental lines.

Farm households are equipped with ranges, electric refrigerating machines, washing machines, irons, vacuum cleaners, dishwashers, water heaters, motors for sewing machines, fans, curling irons, toasters and percolators.

About the farmstead electricity is sawing the wood, grinding the feed, cutting the silage, running numerous shop tools, threshing the grain, hoisting the hay, mixing concrete, drying hay and grains, elevating grain, irrigating waste lands, and performing countless other tasks.

However some of these applications are crude and some of them have been very difficult of accomplishment. The real point is that the farmer never is going to become a considerable power consumer until it is made possible for him to obtain electric equipment for these tasks as readily as he can obtain electric equipment for his cream-separator. When that day is reached, the farmer will be found ready to apply electricity to agriculture.

No further progress has been made during the past year regarding the application of electricity to field work. In a number of places individuals are working on this problem but it must still be looked upon as an experimental adventure.

SOME RESEARCH FEATURES OF THE APPLICATION OF ELECTRICITY TO AGRICULTURE

A paper was presented on this subject at the eighteenth Annual Meeting of the American Society of Agricultural Engineers June 17-20, 1924, at Lincoln, Nebraska, by R. W. Trullinger, Specialist in Rural Engineering, office of Experiment Stations, U. S. Department of Agriculture, and can be obtained from the Department of Agriculture, Washington, D. C.

The committee feels that Mr. Trullinger has presented a most able treatment of the research features involved in rural electrification and that he has merited the commendation of our industry for the assistance he is rendering in solving the many and intricate problems which this subject presents.

Mr. Trullinger sounds the key note of the whole problem when he says in his introduction that the only way to secure a general electrification in agriculture, profitable to the farmer and to the utility, is to increase the use of electricity on each independent farm beyond that met with in ordinary practice today. This can only be accomplished by educating the farmer through the dissemination of information, founded both on research and practical application, demonstrating the feasibility and economy of the various uses in which electricity can be employed.

House heating, as brought out by Mr. Trullinger, may in the milder climates offer some possibility of utilizing energy; however, this method of heating is being carefully studied and a number of research experiments are being conducted along this line. The Idaho Utility Commission has recently issued a report giving the results of a study made by it on the subject of house heating by electricity. This report states that this method of heating is not practicable in Idaho.

Economical cooking is of necessity a local prob-

lem depending on the cost of electricity and of other fuel in a particular locality. However, this offers one of the most feasible and quickest methods of building up the use of electricity on the farm that has been found. Mr. Trullinger is right in stating that "installing some kind of commercial electric stove on every farm" is not all that is required, but we believe that most of the recognized electric ranges on the market today reflect the latest progress in the art of making them. The training of the housewife in the proper use of the new home appliance is as important as the appliance itself. As an example of what is meant, the training of the user of the automobile in handling the machine is as big a factor in the successful use as the work of the designer and manufacturer. On the other hand, it is hardly fair to make a comparison of electric and gas cooking without stating the comparative unit prices of the two commodities upon which the tests were based.

Allied with cooking as a load producer, although not nearly in such general use, we believe electric refrigeration, along with food preparation and curing of meats, which Mr. Trullinger mentions, offers excellent possibilities.

The traction problem, while offering by far the largest potential field in total horse power required, is the hardest one to solve, both on account of the cost of the initial installation of equipment and particularly on account of the large capacity required for short seasonal use.

We are thoroughly in accord with the statement that the miscellaneous power operations about the farm house and yard offer one of the biggest opportunities for building up a substantial and economical rural electrical load. The problem here is principally one of keeping the connected load to a minimum and to find sufficient uses throughout the year to which that load can be applied. Short seasonal use makes farm operations difficult to electrify on an economical basis.

Dairying offers excellent prospects as a rural load and in many sections of the country ranks among the leading revenue producers for individual installations.

RULES FOR SUPPLYING RURAL ELECTRIC SERVICE

Since the last report of this committee there has been very little change in the rules and regulations for the furnishing of electric service adopted by various states.

The 1922 and 1923 reports of this committee described the Oregon rules. Recently these rules were modified tending to simplify them somewhat. It is interesting to note that these modifications also provide that the monthly rural charge which is based on a percentage of the original construction cost in excess of that for urban conditions be increased from 0.8 per cent per month to 1 per cent per month.

Other than this, there have been no changes in

the rules and regulations of any of the states. However, since the last report the Nebraska statutes providing for Light, Heat and Power Distribution Districts have been declared unconstitutional.

Rules and regulations for rural service are being discussed with utilities and utility associations, or are under consideration by the regulatory bodies

in New York, Michigan, Virginia, North Dakota, Colorado, and Idaho.

Rates, rules and regulations regarding rural electric service recently have been filed by the Northern States Power Company and accepted by the Railroad Commission of Wisconsin, and are shown in Appendix B.

APPENDIX A

SUMMARY OF THE NATIONAL FARM POWER SURVEY

By C. D. KINSMAN

Senior Agricultural Engineer, U. S. Department of Agriculture

An address before the Eighteenth Annual Convention of the American Society of Agricultural Engineers, at Lincoln, Nebraska, June 18, 1924.

"The purpose of the farm power survey that has been under way the past year by the Department of Agriculture has been to assemble all available data on the sources and uses of power on farms in the United States.

"As outlined in the beginning, the survey was to include the collecting of all data available on the number, distribution, size and types of farms; the amounts and kind of live stock kept; the kinds of crops raised with the average acreage and yields of each; the number and distribution of work animals, various kinds of mechanical power units and the number of agricultural workers, both regularly and intermittently employed.

"The total amount of each kind of power used was then to be determined; and the amount required for each farm operation, the production of each principal commodity and for the operation of the various types and sizes of farms.

"A large amount of material bearing on the subject has been assembled and has been analyzed according to the above headings. Much of the material collected is based on Census figures and can be considered very reliable; while the figures on power requirements of operations and commodities which have been computed from a rather limited amount of data must be considered only approximately correct. So many factors enter into the determination of their values that a much larger amount of experimental data will be necessary before they can be accurately determined for all conditions.

"The importance of the use of farm power as a problem for study may be suggested by the following information brought out in the survey. More primary power is used by agriculture at the present time than in any other industry with the exception of transportation. All manufacturing industry combined has only about half as much power available as has agriculture. The cost of power used on farms in the United States at present values is about \$3,000,000,000 annually. However, by the use of this power, together with modern labor saving equipment, the American farmer is enabled to increase his production per man by at least three

times over what was possible with hand methods 75 years ago.

"That an extremely close relationship exists between the amount of power and machinery used per worker and the volume of production is conclusively shown by the following illustrations.

"In Fig. 1 is shown the increased crop acreage that has taken place in the United States since 1850.

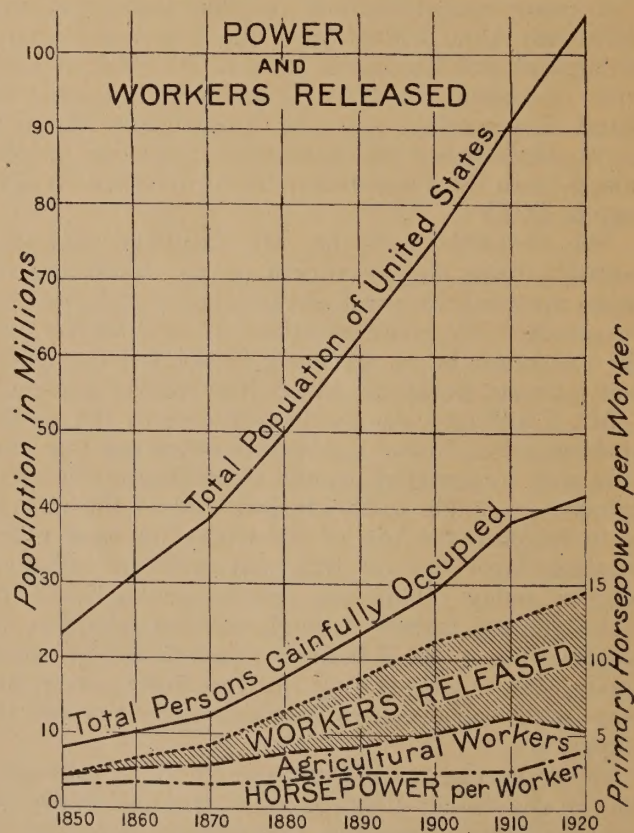


FIG. 1—WORKERS RELEASED FROM AGRICULTURE, 1850 TO 1920.

The shaded portion shows the increase that may be attributed to the increased production per worker and is without doubt almost entirely due to the greater use of power and machinery.

"Fig. 2 shows the proportion of workers that have been released from agriculture due to the

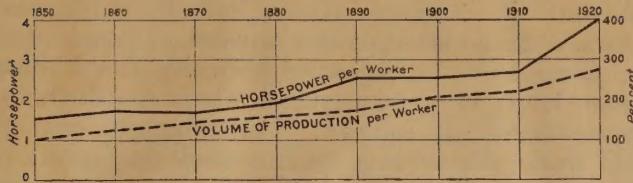


FIG. 2—RELATION BETWEEN POWER AND VOLUME OF PRODUCTION, 1850 TO 1920.

increased production per worker. Since food is the primary need of mankind, agriculture is the basic industry. In early times it required practically the entire efforts of the human race to provide sufficient food and shelter to sustain life and it has been only by increasing the efficiency of those engaged in producing food that others have been released to provide the comforts and luxuries that go to determine our standard of living. It has been estimated that at the beginning of the last century it required over 90 per cent of the workers of this country to produce sufficient food for the nation while at present about 25 per cent of those gainfully employed, with the aid of power and modern machinery are able to produce not only enough for our own people but also a considerable surplus for export.

"Fig. 3 and 4 show how closely the relationship exists at the present time in the various States and in European countries between the power available and the production per worker. Fig. 5 shows that the same relation exists between horse power hours utilized and the volume of production.

"In Fig. 6 is shown a comparison between agricultural and other industries based on 1919 values.

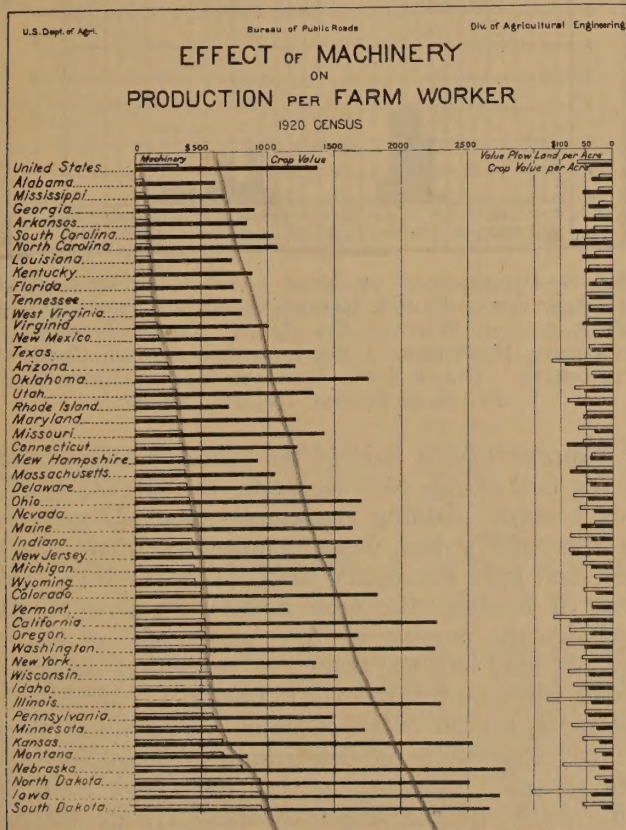


FIG. 3.

Several of the weak points of the agricultural industry are brought out in this chart. While the value of the product of the agricultural worker is less he puts in longer hours and has a higher investment per primary horsepower than any other industry.

"In Fig. 7 is shown an estimate of the total primary horse power that has been available on farms in the United States since 1850.

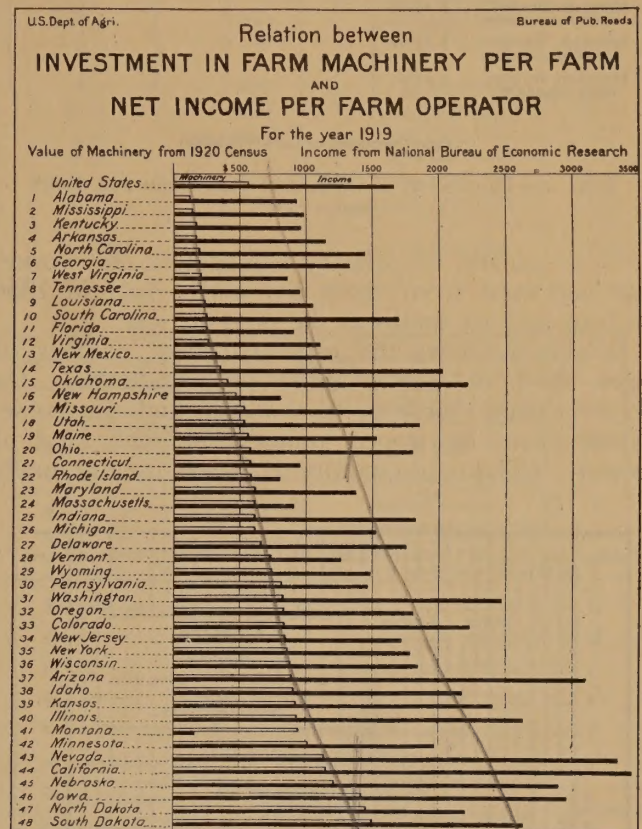


FIG. 4.

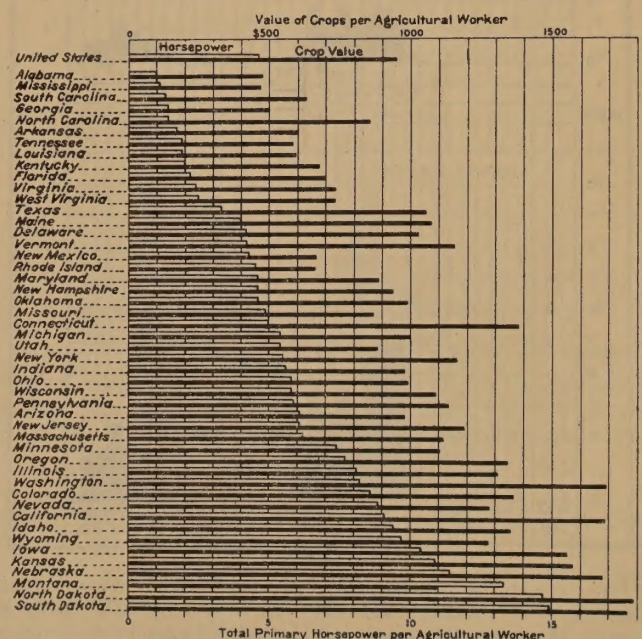
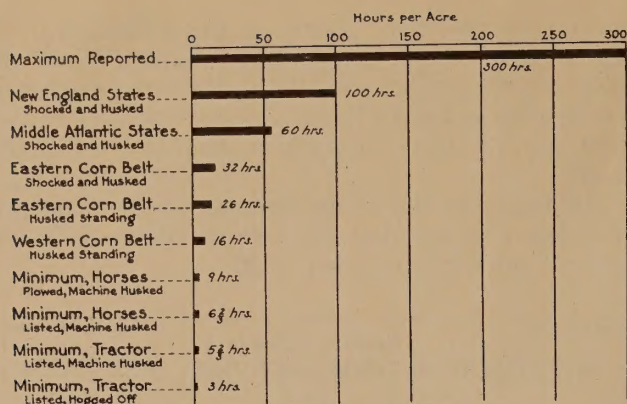


FIG. 5—RELATION BETWEEN PRIMARY POWER AND VOLUME OF PRODUCTION PER WORKER.



Labor Required for Corn Production

FIG. 6—HOURS OF MAN LABOR REQUIRED FOR CORN PRODUCTION.

"The amount of primary horsepower per worker has increased from about one and a half in 1850 to four and six-tenths at the present time.

"Table I shows the estimated total number of each kind of power units or installations, the total primary horsepower available and the horsepower hours developed annually by each kind of power. (The total quantity of power used annually

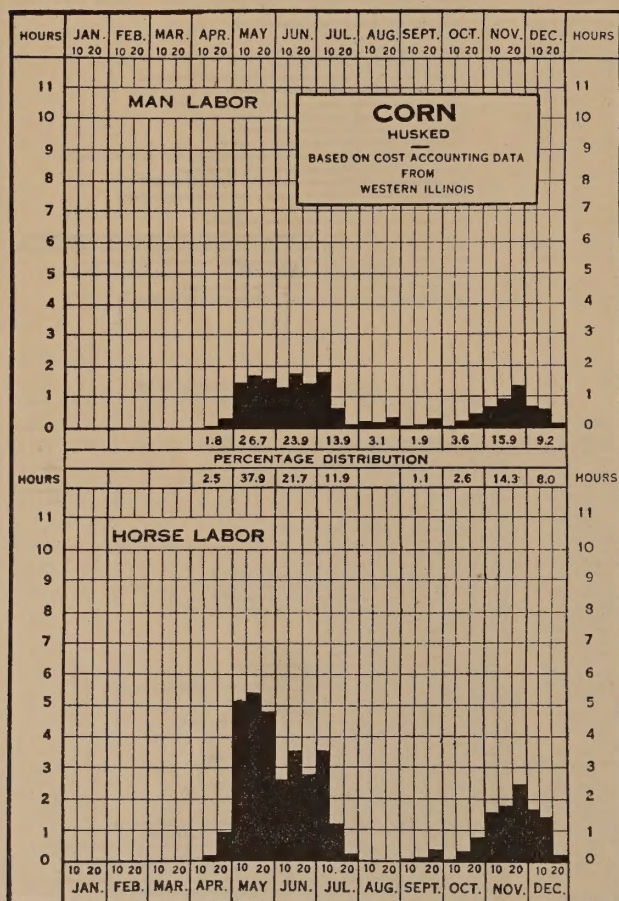


FIG. 7—DISTRIBUTION OF MAN LABOR AND HORSE LABOR FOR 9 FARMS PRODUCING A TOTAL OF 426 ACRES OF CORN. MOST OF THE CORN ON THESE FARMS WAS HUSKED FROM STANDING STALKS. BLACK BARS INDICATE TOTAL HOURS SPENT PER ACRE DURING 10-DAY PERIODS.

amounts to almost sixteen billion horsepower hours.) In addition to this amount of power used on farms there is expended annually about thirty billion hours of human energy which is distributed approximately as follows: Forty-five per cent on field work; 35 per cent on live stock operation; 15 per cent on hauling and 10 per cent on care of equipment. This does not include the work done by women in the house.

"Fig. 8 shows how the above power is utilized by the various major farm operations.

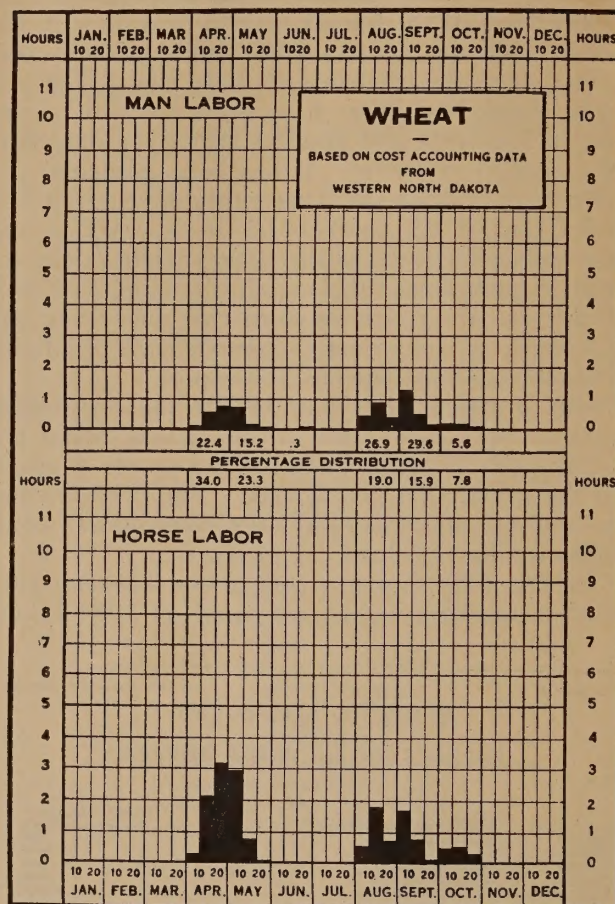


FIG. 8—DISTRIBUTION OF MAN LABOR AND HORSE LABOR PER ACRE FOR 16 FARMS, REPRESENTING THE PRODUCTION OF 960 ACRES OF WHEAT. ON 11 OF THESE FARMS THE THRASHER FURNISHED A PART OR ALL OF THE CREW FOR THRASHING. BLACK BARS INDICATE TOTAL HOURS SPENT PER ACRE DURING 10-DAY PERIODS.

"Approximately half of the power used on farms is for field work, plowing being the largest item in this group. Hauling represents about 22 per cent of the total power, heavy stationary work 17 per cent and light stationary work 11 per cent. In the case of hauling, the total amount of power given includes the moving of the tare weight as well as the net load and the return of the empty wagon or truck when no return load is hauled. Pumping and threshing are the only two items for stationary work shown separately on the graph. The other items are so small individually that they have been left off. Some of the larger of these are as follows: cutting silage requires approximately 50,000,000

TABLE I

APPROXIMATE PRIMARY HORSE POWER AND HORSE POWER HOURS UTILIZED ON FARMS IN UNITED STATES ANNUALLY

Kind of Power	Total Units or Installations	Total Primary Horse Power		Average H. P. Hours Per Primary Horse Power	Total H. P. Hours Developed Annually	
Work Animals.....	21,868,000	21,660,000	44.1%	447	9,690,000,000	61.4%
Gas Tractors Draw Bar.....	400,000	4,000,000	.....	225	900,000,000	5.7
Belts.....	.....	8,000,000	16.3	79	632,000,000	4.0
Steam Tractor.....	50,000	2,500,000	5.1	400	1,000,000,000	6.3
Trucks.....	356,000	7,120,000	14.5	80	570,000,000	3.6
Stationary Engines						
Large.....	20,000	500,000	1.0	892	446,000,000	2.8
Small.....	2,480,000	6,820,000	13.8	820	1,500,000,000	9.5
Windmills.....	1,000,000	500,000	1.0	400	200,000,000	1.3
Electricity Individual Plants.....	300,000	900,000	1.8	167	150,000,000	1.0
C. Sta. Small.....	170,000	680,000	1.4	143	100,000,000	0.6
C. Sta. Large.....	20,000	500,000	1.0	1,200	600,000,000	3.8
Total.....	.....	49,180,000	100%	320	15,788,000,000	100%

TABLE II

APPROXIMATE POWER REQUIRED FOR FARM OPERATIONS

Field Operations

Operation	Conditions	Draft Pounds per Foot in Width Covered	Horse Power Hours per Acre
Plowing 6" deep....	Sandy loam....	200-400	4.5-9
Plowing 6" deep....	Sandy clay loam....	350-500	8-11
Plowing 6" deep....	Clay loam....	400-600	9-13
Plowing 6" deep....	Heavy clay....	600-1000	13-22
Plowing 6" deep....	Gumbo.....	1000-1500	22-33
Peg Tooth Harrow..	Average.....	15-60	0.3-1.3
Spring Tooth Harrow	Average.....	25-70	0.5-1.5
Disk Harrow (Single)	Clay Loam....	70-100	1.5-2.2
Disk Harrow (Single)	Heavy clay....	100-150	2.2-3.3
Land Roller.....	Average soil....	20-80	0.4-2.0
Drilling Grain.....	Average soil....	20-80	0.4-1.8
Mowing.....	Average soil....	35-70	0.75-1.5
Raking (Dump Rake)	Average soil....	15-25	0.3-0.6
Raking (Side Dol.)	Average soil....	20-40	0.4-0.8
Hay Loader (and Wagon).....	Average soil....	50-100	1.1-2.2
Grain Binder.....	Average soil....	60-100	1.3-2.2
Grain Header.....	Average soil....	50-80	1.1-1.8
Header Thresher...	Average soil....	90-180	2.0-4.0
<i>Draft per row</i>			
Corn Planter.....	Average soil....	130-300	1.0-2.5
Corn Cultivator....	Average soil....	130-300	1.0-2.5
Corn Binder.....	Average soil....	300-600	2.5-5.0
Corn Picker.....	Average soil....	1000-1800	7.5-14.0
Potato Digger.....	Average soil....	600-1000	5.0-7.5
Stalk Cutter.....	Average soil....	130-250	1.0-2.0

horsepower hours; shelling corn about 80,000,000; shredding corn 100,000,000; baling hay 100,000,000; grinding feed 200,000,000; operating isolated electric lighting plants 150,000,000; sawing wood and lumber 100,000,000. The remainder of the stationary power is used for small operations around the farmstead such as operating line shafts, churns,

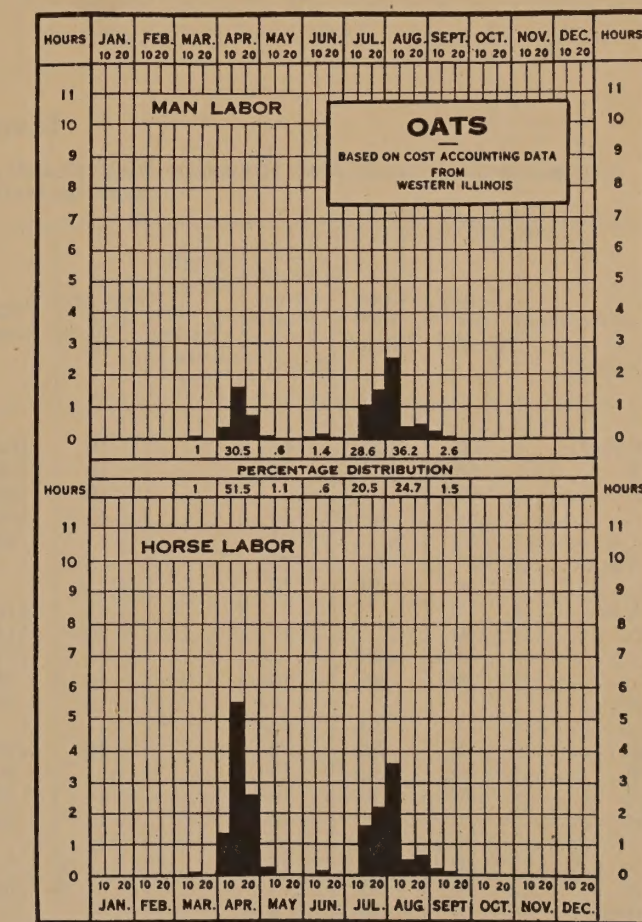


FIG. 9—DISTRIBUTION OF MAN LABOR AND HORSE LABOR FOR 22 FARMS, WHICH PRODUCED A TOTAL OF 891 ACRES OF OATS. BLACK BARS INDICATE TOTAL HOURS SPENT PER ACRE DURING 10-DAY PERIODS.

cream separators, milking machines, washing machines, spray pumps, tool grinders, cleaning and grading grain, hay hoists, elevating grain and other miscellaneous jobs. In the figures given for pumping about one-third is for domestic purposes and the other two-thirds for irrigation and drainage.

TABLE III
APPROXIMATE POWER REQUIRED FOR FARM OPERATIONS

Hauling			Belt Operations		
Road Bed	Draft per Ton Gross Load	Horse Power Hours per Ton Mile, Gross Load	Operation	Unit	Horse Power Hours per Unit
Concrete Pavement.....	20-30	.05-.08	Threshing Wheat or Rye...	100 bu.	20-40
Water Bound Macadam....	60-80	.15-.20	Threshing Oats or Barley...	100 bu.	10-25
Gravel (good condition)...	80-100	.2-.25	Threshing Peas or Beans...	100 bu.	20-40
Earth (dry and firm).....	80-100	.2-.25	Hulling Alfalfa or Clover...	100 bu.	100-300
Hay Stubble (dry).....	100-200	.25-.50	Shredding Corn.....	100 bu.	20-40
Corn Stubble.....	150-300	.40-.80	Shelling Corn.....	100 bu.	4-8
Plowed Ground.....	300-500	.80-1.3	Cleaning Grain.....	100 bu.	2-10
			Elevating Grain.....	100 bu.	.2-.5
			Grinding Grain.....	100 bu.	10-30
			Cutting Silage or Feed.....	ton	.9-2.5
			Baling Hay or Straw.....	ton	2-6
			Pumping Water (Centrifugal pump).....	1,000 gal. ft.	.005-.01
			Pumping Water (Reciprocating Pump), Small.....	1,000 gal. ft.	.01-.02

TABLE IV
APPROXIMATE AVERAGE MAN HOURS OF LABOR PER ACRE REQUIRED FOR CROP PRODUCTION IN VARIOUS PARTS OF THE UNITED STATES

Area	Corn for Grain ¹	Corn for Silage	Small Grain Cut With Binder ²	Small Grain Cut With Combine ²	Hay per Cutting ³	Potatoes	Tobacco	Cotton ⁴	Rice	Sugar Beets	Truck Crops	Fruit	Cow Peas and Soy Beans ²
New Eng.....	100	100	42	...	10	100	...	...	...	...	...	...	...
N. Y.....	66	58	24	...	10	100	...	...	...	...	...	170	42
N. J.....	69	...	...	...	10	100	...	...	...	...	190	...	...
Pa.....	50	49	24	...	12	106	...	...	...	...	...	...	...
Va.....	50	...	23	...	...	82	...	...	...	...	...	...	...
W. Va.....	57	57	23	...	8	...	378	...	...	...	...	...	...
Ky.....	46	60	12	...	...	...	363	...	...	...	...	...	18
So. Car.....	...	...	...	...	11	116	...	136	...	...	...	...	...
Ga.....	40	...	15	...	20	115	400	125	...	...	...	...	19
La.....	37	48	...	...	12	137	...	100	37	...	...	...	...
Ark.....	38	48	16	...	16	94	...	112	46	...	...	140	...
Texas.....	...	...	...	...	16	47	...	64	37	...	...	...	...
Mo.....	24	30	15	...	...	...	...	...	...	...	...	...	25
Ohio.....	48	51	20	...	10	120	300	...	...	110	150	...	...
Mich.....	30	32	19	...	...	80	...	...	...	110	...	...	40
Wis.....	30	30	15	...	14	82	...	...	...	...	...	140	32
Minn.....	26	32	12	...	12	58	...	...	...	155	...	...	...
Ind.....	26	30	15	...	12	...	...	...	...	...	...	...	...
Ill.....	20	28	15	...	8.4	...	...	...	...	...	...	...	...
Iowa.....	18	28	...	...	7.5	69	...	...	...	...	...	...	...
Kansas.....	16	26	8.5	5	4	...	...	...	...	...	...	...	...
E. Neb.....	16	26	10	...	6	...	...	...	...	...	...	...	...
W. Neb.....	12	23	7	5	5	...	...	...	...	...	...	...	...
Dakotas.....	13	23	7	...	8	32	...	...	...	...	...	...	...
Colo. Dry.....	...	...	7	5	5	...	...	...	...	...	...	...	...
Colo. Irr.....	...	...	25	...	12	75	...	...	...	124	...	352	41
Utah Irr.....	...	...	...	...	13	114	...	...	...	129	...	...	...
N. W. Irr.....	...	...	24	...	15	...	...	...	...	119	...	400	30
N. W. Dry.....	...	...	17	7	...	...	...	...	...	...	...	...	...

¹Does not include shelling or marketing.

²Does not include marketing.

³Does not include baling or marketing.

⁴Does not include ginning.

"Tables II and III show the average power required for the larger farm operations. The figures given are approximate averages for all conditions in individual cases. The power required may vary as much as 100 per cent, due to the condition of the material being operated on and the condition and efficiency of the machine in use.

"Tables IV and V show the total average amount of labor required for producing the principal commodities in a number of the States. Here again the figures given are only averages and the power for any individual case may vary considerably due to tillage and harvest methods, type of soil, climatic conditions, etc.

"Perhaps the most interesting and also the most important part of the analysis of the material gathered is that showing the primary power and horsepower hours utilized annually per worker and per farm by States. This data is shown graphically in Fig. 9 to 12. The variation in the amount of power per worker is due almost entirely to the size of the machine units in use in the different states, while the amount of power utilized per farm is largely due to the type of farming followed, the

size of farms, the machinery used per worker, the type of soil, and the climatic conditions.

"Fig. 13 shows the horsepower hours utilized annually per improved acre. It is probably the best unit to use when estimating the power requirements of different sized farms.

"The cost of power is the most important part of a power problem and is at the same time one of the hardest on which to give reliable figures. This is due to the great variety of conditions to be met. Some of the factors affecting the cost of power may be stated as follows: First cost of the primary power unit; rate of depreciation; amount of power produced annually by the unit; repairs and labor required for upkeep; mechanical efficiency of the power unit; cost of fuel or feed, etc. In Fig. 14 is shown the average cost per horsepower hour for several kinds of power under 1924 values and is based on developing the number of horsepower hours per primary horsepower shown in Table I. If the fuel or feed costs more or the unit develops less power annually the cost will be greater while if in either case the reverse is true, the cost will be less.

TABLE V

APPROXIMATE AVERAGE POWER IN HORSE POWER HOURS PER ACRE REQUIRED FOR CROP PRODUCTION IN VARIOUS PARTS OF THE UNITED STATES

Area	Corn for Grain ¹	Corn for Silage	Small Grain Cut With Binder ²	Small Grain Cut With Combine ²	Hay per Cutting ³	Potatoes	Tobacco	Cotton ⁴	Rice	Sugar Beets	Truck Crops	Fruit	Cow Peas and Soy Beans ²
New Eng.....	35	50	21	...	5	50	...	...	...	...	...	...	...
N. Y.....	27	42	23	...	5	50	...	...	...	...	...	45	31
N. J.....	27	42	...	...	6	50	...	...	...	...	...	...	...
Pa.....	27	42	22	...	...	54	...	...	...	...	...	...	...
Va.....	30	45	...	...	...	35	...	...	...	...	...	...	...
W. Va.....	30	45	20	...	4	42	27	...	...	...	...	...	...
Ky.....	30	45	15	...	4	...	44	...	...	...	...	...	15
S. C.....	...	...	...	...	...	33	...	30	...	...	...	...	...
Ga.....	22	...	16	...	12	30	45	30	...	...	...	...	13
Ia.....	26	41	23	...	10	42	...	20	38	...	...	...	...
Ark.....	26	41	23	...	9	32	...	26	42	...	40	45	...
Texas.....	...	...	...	...	...	27	...	20	40	...	...	...	...
Mo.....	24	39	18	...	...	...	...	...	...	...	...	...	20
Ohio.....	30	45	20	...	6	50	50	...	...	40	...	...	25
Mich.....	30	45	20	...	...	40	...	...	...	45	40	...	25
Wis.....	27	42	20	...	6	40	...	...	...	...	...	...	22
Minn.....	27	42	20	...	8	35	...	...	...	55	...	...	...
Ind.....	30	45	20	...	...	...	...	...	...	...	...	...	...
Ill.....	26	41	22	...	6	...	...	...	...	...	...	...	...
Iowa.....	26	41	...	...	6	43	...	...	...	...	...	...	...
Kansas.....	22	35	15	9	4	...	...	...	...	...	...	...	...
E. Neb.....	22	35	16	...	5	...	...	...	...	...	...	...	...
W. Neb.....	19	32	14	9	4	...	...	...	...	...	...	...	...
Dakotas.....	19	...	15	...	6	38	...	...	...	...	...	...	...
Colo. Dry.....	...	...	15	9	4	...	...	...	...	...	...	...	...
Colo. Irr.....	...	...	25	...	7	50	...	...	...	55	...	62	20
Utah Irr.....	...	...	...	...	6	58	...	...	...	70	...	...	...
N. W. Irr.....	...	...	25	...	7	50	...	...	...	52	...	70	...
N. W. Dry.....	...	...	14	9	4	...	...	...	...	...	...	...	...

¹Does not include shelling or marketing.

²Does not include marketing.

³Does not include baling or marketing.

⁴Does not include ginning.

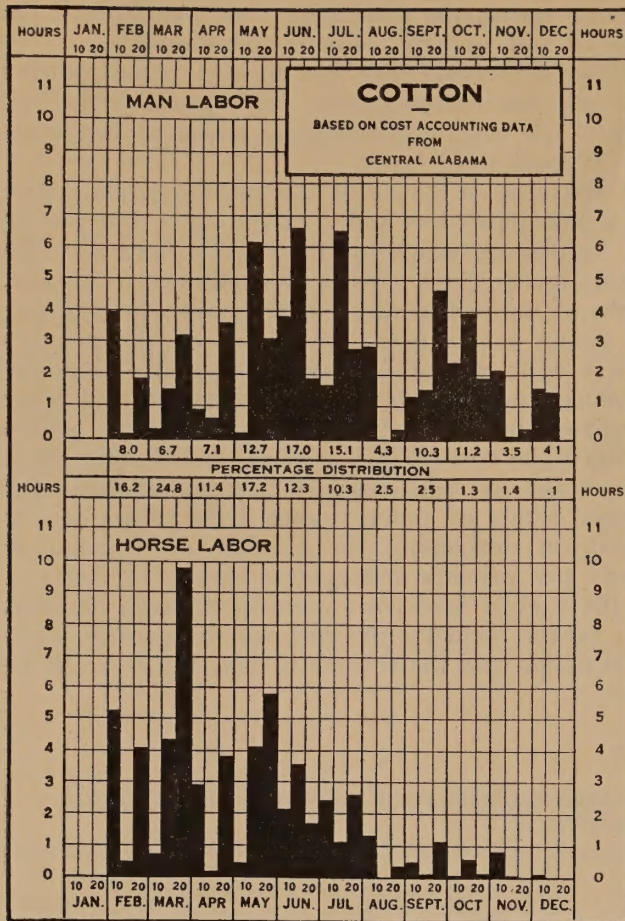


FIG. 10—DISTRIBUTION OF MAN LABOR AND HORSE LABOR FOR ONE FARM DURING A SERIES OF YEARS, REPRESENTING THE PRODUCTION OF 25 ACRES OF COTTON ANNUALLY. LARGE TYPE MACHINERY USED. BLACK BARS INDICATE TOTAL HOURS SPENT PER ACRE DURING 10-DAY PERIODS.

"One of the most serious problems encountered in the substitution of horses with tractor power is the fact that the tractor, as it is now designed, does not entirely displace horsepower on most farms and the horses that are necessarily kept do only about half as much work as before the tractor was purchased. This results in the cost per horsepower hour of the horse labor being materially increased and while under average conditions tractor power costs only about half that of horses, the total tractor bill is actually increased instead of being decreased. Fig. 15 shows graphically the cost of horse and tractor power for varying amounts used annually and the average cost of horsepower when used in conjunction with tractor power.

"In choosing any type of power for farm use, many factors have a bearing, chief of which are as follows: total cost per horsepower hour developed; speed of operation; attention required while in operation; care required while not in use; and convenience of power when wanted. For the small job requiring little power, convenience is the first consideration but for the larger jobs economy of operation will be the deciding factor. The values given in Fig. 14 for the cost of the various kinds of power

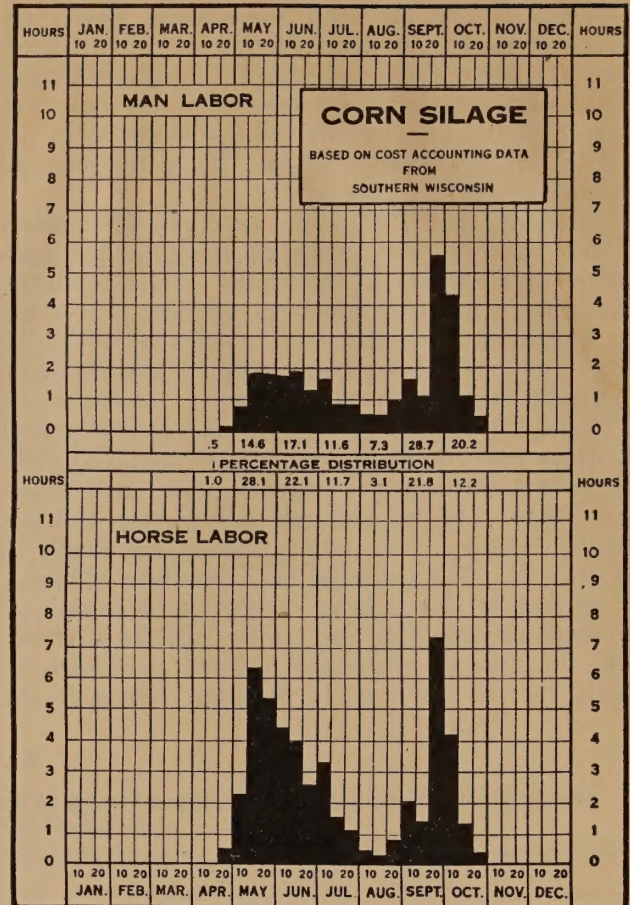


FIG. 11—DISTRIBUTION OF MAN LABOR AND HORSE LABOR FOR 13 FARMS HAVING A TOTAL PRODUCTION OF 325 ACRES OF CORN SILAGE. BLACK BARS INDICATE TOTAL HOURS SPENT PER ACRE DURING 10-DAY PERIODS.

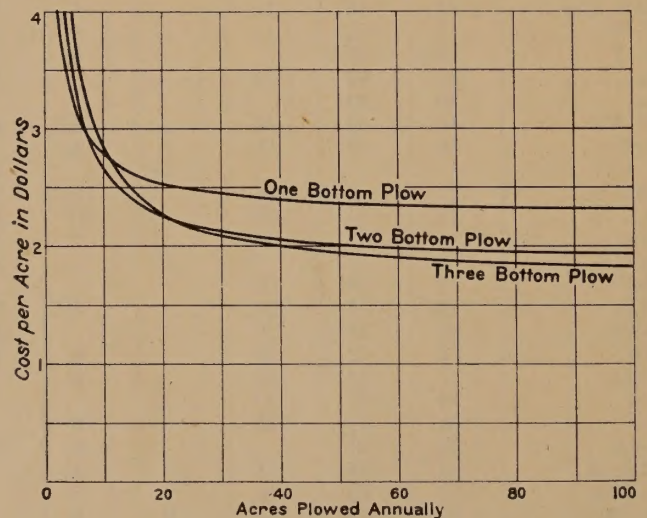


FIG. 12—COMPARISON OF COST OF USING ONE-, TWO-, AND THREE-BOTTOM PLOWS.

may be used as a guide in considering what rates must be given if electricity is to compete with the kinds of power now generally used in farm work. Local conditions and varying costs of fuel and feed will of course have an influence on the values given."

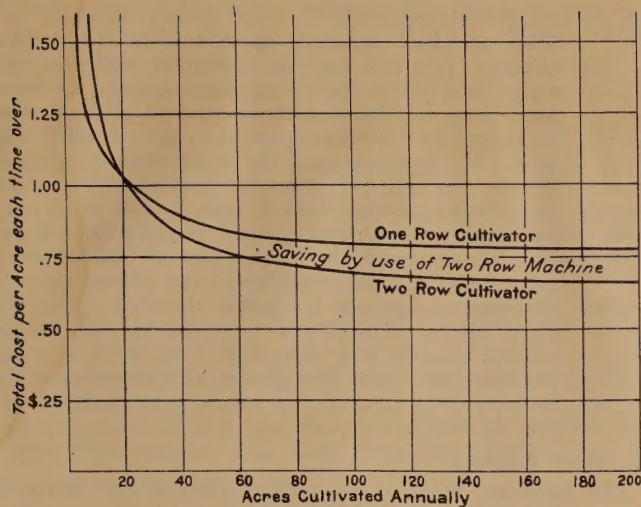


FIG. 13—COMPARISON OF COST OF USING ONE- AND TWO-ROW CULTIVATORS.

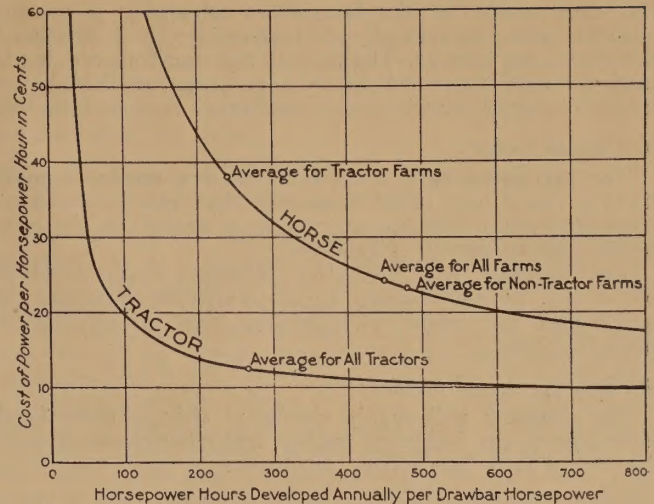


FIG. 14—COMPARISON OF COST OF HORSE AND TRACTOR POWER.

APPENDIX B

RATES, RULES AND REGULATIONS APPLICABLE TO RURAL SERVICE AS FILED WITH THE RAILROAD COMMISSION OF WISCONSIN BY THE NORTHERN STATES POWER COMPANY

1. Rural Service Defined:

Rural Service shall include all service rendered from the company's high tension lines, or from lines attached thereto and built primarily for such service, serving customers living outside the corporate limits of any city, village or town or in a locality where the density of population is less than that encountered ordinarily in urban districts and where no other existing rate schedules or rules governing financing of lines apply. Industrial establishments such as blacksmith shops, garages, creameries, etc., are specifically excepted from the operation of such rates, rules and regulations.

2. Analysis of Extension:

When one or more prospective rural customers make application for electric service the utility will investigate the extension, ascertain the number of customers who can be advantageously served, and the number who will contract for service under the terms herein prescribed; and if requested to do so will estimate the construction cost as outlined in Section 4.

3. Construction of Rural Lines:

Rural lines may at the option of the customers be built by the company or by the customers themselves in accordance with specifications furnished by the company.

4. Cost of Extensions:

The cost of rural extensions, when built by the company, shall include all material, labor and other expense required for the distribution and installation of poles, wire cross-arms, insulators, line hardware, switching and protective devices, transformers, appurtenances, right-of-way permits, etc. Metering equipment shall be supplied by the utility and cost of same shall not be included in the estimated construction cost. An item not exceeding 10 per cent of material cost may be included to cover purchasing expense, freight, cartage to storeroom and stores department expense.

An item not exceeding 15 per cent of all above-mentioned

items may be included to cover general overhead, engineering, promotion, office supervision, clerical labor, contingencies, etc.

5. Financing:

All rural lines shall be financed wholly by the prospective customers, and in the event the line is to be built by the company, the customers shall advance to the company, or shall place in escrow in a suitable depository subject to the company's draft accompanied by invoice, the estimated cost of the extension as defined under Section 4. The difference between the actual and the estimated construction cost shall be adjusted when the line is completed.

6. Rural Service from Transmission Lines:

Rural service will be furnished to customers directly from transmission lines when rural lines are not available and when service and voltage conditions render such service feasible. Service from transmission lines having voltages in excess of 13,200 volts will be treated as special by the company and will not come within the operation of this schedule of rates, rules and regulations.

7. Connection Charge—Combined Transmission and Rural Extension Lines:

The cost of transmission lines built for the joint service of rural customers and urban customers will be apportioned between such classes of service, in those cases where the revenue to be derived from such urban business alone is not sufficient to justify the building of the extension. The proportion which each class of service shall bear shall be determined by agreement of the parties interested, or, at their request, the Railroad Commission of Wisconsin, will so determine.

The amount so determined shall be apportioned among and collected from the rural customers involved in accordance with Section 8 hereafter.

8. Method of Apportioning Cost of Extension Among Customers:

The cost of the main line extension shall ordinarily be apportioned equally among the customers, but this shall not prevent any customer who may so desire, in order to assure

the construction of the line, from advancing a greater amount either permanently or temporarily until additional customers are secured. The cost of the transformers, lightning arresters, fuses and service connections, shall be borne by the customer for whom such equipment is to be installed.

9. Title to Line:

The title to all rural lines, transformers, service connections or loops, and other equipment shall rest in the company through a suitable instrument executed by the customers before service is rendered.

The company will thereafter recognize the connection of service as appertaining to the particular premises to which such instrument refers without right of transfer to other locations.

10. Rate for Rural Service:

The company will supply service at charges determined according to the following method and apportioned according to methods hereinafter set forth:

SERVICE CHARGE: The monthly service charge shall be one-twelfth of the sum of the following three amounts:

A. Company's General Investment:

\$9.00 per kv-a. per year for each kv-a. of installed transformer capacity.

B. Company's Special Investment:

15.5 per cent per year of the total investment of the company assigned to the customer, in transmission and / or farm line, transformers, protective devices, service connections, meters, etc.

C. Customers' Investments:

6 per cent per year of the total investment of the customer in transmission and / or farm line transformers, protective devices, service connections, etc.

ENERGY CHARGE: In addition to the service charge, all energy used shall be paid for at the following rates:

First 30 kw-hr. per month at 10c per kw-hr.
All over 30 kw-hr. per month at 3c per kw-hr.

DISCOUNT: A discount of 10 per cent will be allowed on the energy portion of bills if paid within 10 days from date of bill.

MINIMUM BILL: The net charge for energy under "Energy Charge" above shall not be less than \$1.00 per month.

11. Determination of Customers' Service Charge:

The following rules govern the application of that part of Section 10 relating to the computation of service charges.

A. Company's General Investment:

The rated capacity of the transformer installed for each customer shall control in the application of that part of Section 10 applying hereto.

Where two or more customers are connected to the same transformer, the total connected load of each shall be taken as determining the proportion of transformer capacity assignable to each such customer.

B. Company's Special Investment:

The principal amount upon which the annual charge of 15.5 per cent is computed shall be that proportion of the local transmission line and / or farm extension, determined in accordance with Section 8, assigned to the customer, plus the total amount invested by the company in transformers, protective devices, meters, service connections, etc., for the supplying of energy to that customer.

C. Customer's Investment:

The principal amount upon which the annual charge of 6 per cent is computed shall be that proportion of the local transmission and / or farm extensions, determined in accordance with Section 8, assigned to the customer, the cost of which has been paid by him, plus the total amount invested by the customer in transformers, protective devices, service connections, etc. But when any customer has voluntarily paid more than his pro rata share under the provisions of Section 8 in order to assure construction of the extension, such customer shall not be billed on more than his equal share of the total cost, except at his expressed assent, and the total cost shall for the purposes of this section be distributed equally among all customers for whose benefit the donation is made.

12. Meter Reading:

The company may, at its option, require the customer to read his own meter and report such reading on suitable forms furnished by the company. Such reading will be supplemented by periodic reading by representatives of the company.

13. Maintenance:

The company will perform all maintenance and service work on the rural lines, transformers, protective devices, service connections, etc., which may be required to furnish satisfactory service.

14. Inspection:

The company will inspect the installations of its rural customers before service is furnished. Such installations must conform to the rules of the company and be approved by its inspector before meters will be installed. In the event the customer shall desire at any time to add any equipment to his installation, he must first notify the company so that the proper transformer and meter equipment may be provided.

15. Access:

The company reserves the right of free access to the customer's premises at all reasonable times for the purpose of reading meters or inspecting any of the equipment by any of its authorized employees.

16. Term of Contract:

Rural service will be supplied by the company under contract with each individual customer. Such contracts shall be for a term of one year, continuing in force thereafter from year to year.

17. Default in Payment:

If the customer shall be in default in the payment of bills rendered by the company for a period of thirty days or more the company may at its option discontinue service to such customer, but such discontinuance shall not abrogate any of the rights of said company under its contract.

18. Reconnection Charge

A charge of \$3 will be made for reconnection when service has been discontinued because of nonpayment of bills or for other default on the part of the customer.

19. Connection of Additional Customers:

When an additional customer desires service from an extension originally paid for under the provisions of Section 8 and can be connected to the extension at a less cost, excluding cost of transformers, service connection, etc., than the pro rata cost to the original customers, then the company will collect in advance from the additional customer an amount equivalent to the average cost to an original customer. The amount by which this sum is greater than the actual cost of connecting the additional customer, as determined when the extension is built, will then be distributed pro rata to all customers on the line, including the additional customer, the intent being to constantly main-

tain an equal shares basis of participation in construction cost.

In case the cost of connecting the additional customer is greater than the average cost to the original customer, then the estimated cost shall be collected in advance, adjustment made upon completion of the extension, and no refunds made to the original customers.

When further extensions to the line are made the above rule shall be applied in such manner that any refunds which may be made to customers previously served shall be distributed in such manner as to equalize the investment of such customers previously served.

Nothing in these rules and regulations shall be deemed to determine the connection charges or basis of service to hamlets, towns or communities, service to which is made available by the construction of such lines, such connection charges and basis of service being expressly reserved for separate consideration and adjustment in view of the particular circumstances and facts pertaining thereto.

20. Construction Standards:

The standard of construction of rural lines shall conform to the construction standards of the company, which standards are hereby made a part of these rules and regulations, and to the Wisconsin State Electrical Code.

21. Construction Prior to 1924—Determination of Cost:

The rates, rules and regulations herein established contain certain elements dependent upon the amounts invested by rural customers and the company. Such amounts shall be determined from the books of the company, in so far as possible. Where such process is not possible, due to construction of lines by parties other than the company or due to loss of records, the company will prepare an estimate of the cost of said line or lines to be used in lieu of actual costs and will present same to the customer or customers. In case of disagreement, the Railroad Com-

mission of Wisconsin will be asked to arbitrate. The respective amounts contributed by rural customers and the company will also be determined from the books of the company in so far as possible, aided by customer's receipts or other evidence when presented by the customer in substantiation of his claim.

22. Application of Rates, Rules and Regulations to Customers Served Prior to 1924:

The rates, rules and regulations as above established, approved by the Railroad Commission of Wisconsin on, 1924, shall apply to all customers attached to the company's lines after October 1, 1924.

Any customer attached prior to October 1, 1924, may now, or at any future date during the limitation period hereinafter set forth, elect to be served under this schedule.

Customers attached prior to, 1924, who do not elect to be served under this schedule, will be continued on their present system of rate charges until a period of five years from date of connection to the individual customer at his location as of, 1924, shall have elapsed. After such five year period, such customer shall automatically be placed under the operation of this rate schedule; provided, however, that no such five year period to any individual customer shall be deemed to expire within two years from date of order, 1924.

The five year period of limitation shall apply to each rural customer as at his existing location on, 1924, and to no other location.

23. Right of Appeal to Railroad Commission:

Nothing in the foregoing sections shall be deemed to limit the right of the company or the customers to appeal to the Railroad Commission of Wisconsin for decision in matters under its jurisdiction as to the respective rights of the company and the customer.

REPORT
OF
RURAL ELECTRIC SERVICE
COMMITTEE
1925-1926

To be presented at the Forty-ninth
Convention, Atlantic City, N. J.
May 17 to 21, 1926

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FOREWORD

This report has been prepared and edited by the
RURAL ELECTRIC SERVICE COMMITTEE
for presentation at the Forty-ninth Convention of the
Association, at Atlantic City, N. J., May 17 to 21, 1926

PERSONNEL OF THE COMMITTEE

Chairman, G C NEFF, Wisconsin Power & Light Co, Madison, Wis
E W ASHMEAD, Alabama Power Co, Birmingham, Ala
C A ATHERTON, National Lamp Works of G E Co, Cleveland, Ohio
F A BELDEN, The Edison Electric Illuminating Co, Boston, Mass
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O H HUTCHINGS, The Dayton Power & Light Co, Dayton, Ohio
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BERT H PECK, Illinois Power & Light Corp, St Louis, Mo
CHARLES F STUART, Northern States Power Co, Minneapolis, Minn
W K VANDERPOEL, Public Service Electric & Gas Co, Newark, N J

Geographic Division Representatives

Canadian—R J BEAUMONT, The Shawinigan Water & Power Co, Montreal, Can
Eastern—
East Central—J B JOHNSON, The Ohio Public Service Co, Elyria, Ohio
Great Lakes—EUGENE HOLCOMB, Consumers Power Co, Jackson, Mich
Middle West—ARTHUR HUNTINGTON, Iowa Railway & Light Co, Cedar Rapids, Iowa
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North Central—L O GORDON, W B Foshay Co, Minneapolis, Minn
Northwest—LEWIS A MCARTHUR, Pacific Power & Light Co, Portland, Ore
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Southeastern—E W ASHMEAD, Alabama Power Co, Birmingham, Ala
Southwestern—A G CURTIS, Southwestern Gas & Electric Co, Shreveport, La

CONTENTS.

	PAGE
General	1
A Message to Presidents and General Managers	1
Cooperative Investigation	2
Cost of Rural Lines	2
Plan for Rural Service Department	3
Commission Orders	3
Appendix A—General Rural Extension Plan of Adirondack Power and Light Corporation, Schenectady, New York	3
Appendix B—Rural Service Plan of Ohio Public Service Company, Cleveland, Ohio....	6
Appendix C—A Plan of Supplying Rural Electric Service of the Iowa Railway and Light Company, Cedar Rapids, Iowa	7
Appendix D—A Plan of Supplying Rural Electric Service of the Wisconsin Power and Light Company, Madison, Wisconsin	10
Appendix E—General Order No. 27 Public Service Commission of the Commonwealth of Pennsylvania Establishing Rules and Regulations for Rural Service	14

RURAL ELECTRIC SERVICE COMMITTEE

General

The Rural Electric Service Committee has held three general meetings during the fiscal year. The Committee, through its members, has attempted to keep in close touch with the experimental work concerning rural electric service being carried on in a number of states, and has endeavored to assist in this work wherever it could. The Committee believes that the problems of rural electrification are better understood than ever before. Many utility companies are preparing to properly handle the utility problems connected with this service as is evidenced by the organization of Rural Electric Service Departments in nineteen companies in thirteen states. Utility companies further demonstrate that they are beginning to understand rural electrification through a more generous attitude in the financing of rural lines and through the adoption of a rate schedule which properly protects the utility investment but which at the same time encourages greater use of energy by the farm customer.

Many agricultural men who have given much time and study to the subject of rural electrification are convinced that the utility company serving sections not irrigated cannot afford to sell electric service to the farmer at a price he can afford to pay, unless the average consumption of electric energy per farm is increased materially over the present average.

The farm press contains many articles and discussions regarding electric service on the farm, and we should be gratified that these articles show an ever increasing understanding of the fundamental essentials of rural electric service. The editors of agricultural papers are very eager to get more facts regarding this development, and for this purpose held a conference in Chicago on May 12 and 13.

This development of a better understanding of the facts involved should be very beneficial to both the electrical and the agricultural industry. It should be very helpful in preventing misunderstanding between these two great industries, at least so far as rural electric service is concerned.

This better understanding of rural electric service by both the utility and the farmer, together with the wide publicity given this subject by the press, is sure to accelerate the building of electric lines into the country to supply farmers with electric service. This is as it should be, but your Committee wishes to issue a word of caution. Rural electric lines should be built only to groups of farmer customers who can and will agree to use a sufficient amount of energy in a manner that will enable them to profitably pay to the utility which serves them a rate sufficient to pay the utility the cost of the service. If rural lines are built under conditions where either the utility or the farm customer are losing money because of the service there is trouble ahead.

Your Committee believes that the utility company must assume the responsibility of making the necessary studies in advance of line construction to determine whether or not the prospective farm customers

can and will use sufficient energy to make it profitable to them as well as to the utility.

A Message to Presidents and General Managers

This section of the Committee report is addressed in particular to Presidents and General Managers because the Committee desires to recommend most emphatically that every electric service company establish a definite department of Rural Service. Such departments can be established only by the direction of the executive heads of the respective companies.

The need for such departments is paramount. In most companies rural service has been everybody's business, and, as a consequence, nobody's business. No matter how you may regard the future of rural electrification, it is a subject big enough to demand specific attention.

There are two viewpoints from which to regard rural electrification:

1. Public Relations.
2. Future Market.

From the standpoint of public relations, it is very desirable, and becoming more necessary every day that every electric company in the country should meet the farmer and be in a position to talk intelligently with him regarding electric service. Unless you have in your organization a department or individual in possession of all available data and keeping pace with the rapid developments of rural electrification, you cannot deal intelligently with the farmers in your territory. We regard it as essential that every electric company place itself in a position to deal fairly and intelligently with its rural residents.

This Committee is aware that many men in the electrical industry can see no future market for electric energy on the American farm. This might be made the subject of a prolonged discussion, but regardless of your present views it may be of interest to you to know that it already has been definitely determined that the farm can use advantageously many times as much electric energy as is now being consumed by the average city residence. It was only a few years ago comparatively when many men prominent in the electrical industry contended that service to city residences could result in nothing but deficits. Look back a number of years in the files of our convention reports and you will find that many smart men made speeches sustaining this contention. This Committee does not wish to make extravagant promises regarding the farm as a future electrical market, but it is significant that men of the industry who have put in the most time studying this subject are the ones who are most hopeful of living to see the farmer a very acceptable customer to the power company.

The above must make it apparent that from the standpoint of public relations or from the standpoint of a future market for your product, or both, your organization should be thoroughly acquainted with

all problems involved and should keep itself up to date as new developments are occurring almost every day. It may interest you to know that nineteen companies in thirteen states already have created definite rural service departments. Some of the smaller companies cannot afford to assign one or more individuals to give their undivided attention to this subject, but they can at least assign someone to give part time and who will be held individually responsible for this business. The larger companies can assign one or more persons to give their undivided attention to this work.

We recommend that great care should be taken in selecting the person to take charge of this study. He should be a man of many parts. He should know the electrical business and know the farm business. He should know farmer psychology; he should have a sincere interest in the farm and know how to apply electric power to farm operations. He should know salesmanship, construction and human nature, and should finally have the gift of imparting knowledge without offering offence.

To those Presidents and General Managers who see fit to accept and act favorably on this recommendation, this Committee wishes to add an additional suggestion: When this department has been established it is important that you follow it, keep in frequent touch with it, and, above all, make it possible for the head of this department to report to you personally at frequent intervals.

Cooperative Investigation

The following states have organized joint committees for the study of rural electric service:

California —	Indiana —
Oregon —	Michigan —
Washington >	Ohio —
Idaho —	Virginia —
Iowa —	New Hampshire —
Kansas —	Alabama —
South Dakota —	New York —
Minnesota —	Nebraska —
Wisconsin —	South Carolina —
Illinois —	Oklahoma —

Intensive and careful experiments are being conducted on the application of electric service to irrigation, dehydration, poultry raising, general farm water supply, refrigeration, electric cooking, water heating, feed grinding, wood sawing, hay hoisting, elevating and threshing grain, cutting ensilage, drying of farm products, fire prevention, general farm lighting and the use of all kinds of standard household appliances. In some states this work is just starting, in others it has been under way for about two years. Because experience has shown that it takes at least two years to get results on the projects which were first to start and additional time for summarizing and digesting the data, comprehensive results were not available for this report. However, the results clearly show that with types of farming such as dairying, poultry raising, stock raising, fruit growing and vegetable gardening there are possibilities for building a load which will be attractive to the utility company, improve living conditions on the

farm and in many cases show a desirable financial return to the farmer.

In view of these conditions the Committee wishes to earnestly recommend that the electric light and power industry be aggressive and diligent, doing all within its power to see that these investigations are carried to a logical conclusion.

From time to time, through state publications and the bulletin issued by the Committee on the Relation of Electricity to Agriculture, results of these investigations will be made available. In fact, a few have already been published. The committee feels that through these sources the results can be presented in much more detail than would be possible in a report of this character.

Costs of Rural Lines

The Committee endeavored to make a study of the cost of constructing rural electric lines located in different parts of the United States. Considerable information was collected by means of questionnaires. This information discloses the fact that many different types of lines are now being built by different utility companies. Voltages of 2300, 6600 and 11,000 are quite common on the rural lines now constructed. One company reported 13,200 volts as the rural distribution voltage, another company reported that 4800 volts was its standard voltage. The tendency seems to be toward the higher range of voltages, with many companies now standardizing on 6600 volts as proper voltage for rural lines in their particular districts.

The costs of the line as reported on the questionnaires varied a great deal, due largely to the fact that the questionnaire was not properly understood. A number of companies reported the cost of old rural lines which had been built at pre-war prices, thereby making the cost of all such lines far below the cost of similar lines constructed at present day prices.

There is also a difference in the types of construction. Some companies seem to prefer to use small poles and short spans, others prefer to use large poles with long spans. The tendency seems to be toward this latter type of construction, with some companies using spans of over 300 feet. In reporting, some companies included the cost of transformers installed ready to serve the farmers, while others did not.

After taking into consideration and correcting for the above differences the cost of the 6600 volt single phase rural lines varied from a minimum of \$1,200 to a maximum of \$1,984 per mile when completely equipped with lightning arresters, transformers and meters, to serve three customers. This difference in construction cost can be accounted for in one or more of the following ways:

1. In wooded sections the cost of clearing right of way is, of course, very much more than in sections where there are few or no trees.
2. In sections where the digging of holes is difficult, due to the presence of rock or other hard

material, the labor cost is higher than where holes can be dug without difficulty.

3. Some utility companies adopt a long span type of construction, and in this way reduce the cost.
4. The freight rate on poles and cross arms varies considerably in different sections of the country, and this also affects the cost of the line.

The cost of the rural distribution line affects the cost of rural service so much more than the cost of the city distribution line affects the cost of city service that it is important to give the rural distribution line careful study and attention. It is recognized that a line can be built so light that the increased maintenance, operation and replacement costs more than offset savings made through a reduction in interest and taxes. On the other hand, a line can be built so heavy that the fixed charges of interest and taxes become exceedingly high. It is also recognized that in different sections of the country different standards of construction are necessary. It is recommended, however, that any utility company which expects to develop rural electric service on any extensive scale should give intensive study to the type of rural distribution lines to be built.

Assuming that three customers can be served by one mile of line, and assuming fixed costs of 16 per cent, a difference of \$300 per mile in cost of line makes a difference of \$1 per month per customer. This is a material difference in the cost of service, and shows the importance of standardizing on the proper type of rural distribution line. The line should be strong enough to comply with reasonable factors of safety and generally recognized standards, but it should be kept in mind that for the most part rural distribution lines will be very lightly loaded.

Plan for Rural Service Department

In last year's report the Committee made rather

complete and detailed statements regarding a definite plan for the development of rural electric service by utility companies. This plan was designed to encourage increased consumption by the farm customer. The Committee has not found any reason during the past year to change its recommendations regarding this plan and, on the contrary, desires to place added emphasis on them. It is firmly believed that increased use of electric service by the average rural customer is essential to the successful development of rural electric service. In order to do this, however, it is necessary for the farm customer to spend more money for electrical equipment and appliances than the utility will invest in lines to serve him. It is recommended very strongly that any utility company developing a plan for supplying rural service should keep this fact in mind.

The other factor which has a great deal to do with increased consumption is the form of rate itself. A rate which has a large part of the fixed costs distributed over the energy charge makes the bill for service to the small user less than cost and to the large user more than its actual cost. Such a rate penalizes the large user, which is very undesirable. During the past year a number of companies have developed plans for supplying rural service which embody in whole or in part the recommendations of last year's committee.

In the Appendices of this report are shown the plans of four utility companies for supplying rural electric service. While these plans are submitted without recommendation by the Committee, it is believed that they will be of value to anyone who is trying to develop a plan of rural electric service in that it gives information on what is actually being done.

Commission Orders

During the past year the Public Utility Commission of Pennsylvania issued an order concerning the extension of lines to supply rural electric service. Copy of this order is shown in the Appendix A.

APPENDIX A

GENERAL RURAL EXTENSION PLAN OF THE ADIRONDACK POWER AND LIGHT CORPORATION, SCHENECTADY, N. Y.

In working out a program for rural extensions, the matter of an extension policy or a code of extension rules was considered first rather than types of line construction, since, in consideration of the nature of farm operations in this part of the state, and the relative density of distribution centers, it was concluded that, in general, this field could be served with single phase extensions of relatively low primary voltage. Moreover, after giving the matter considerable thought and study, it was agreed that these extensions could be built for an average cost, over the entire territory, of not more than \$1600 per mile. Having then determined that in general extensions of existing distribution systems could be made into rural territory for an average cost of \$1600 per mile, it remained to determine ways and means of financing and paying the fixed and operating costs on such extensions.

In many cases the Company will make the entire investment in the line extension. In other cases the customers

will make cash deposits toward the cost of part or all of the extension. On the money invested by the Company there should be earned annually 8 per cent return and another 8 per cent to cover the cost of taxes, depreciation, extraordinary hazard, etc., or a total of 16 per cent. Where the money for building the line is advanced by the applicant, only the 8 per cent to cover the cost of taxes, depreciation, etc., need be earned.

Thus it has been concluded that 16 per cent annually must be earned on the money invested by the Company, plus 8 per cent on that deposited by the customer. It is proposed to meet these costs through the medium of minimum monthly revenue. That is to say, instead of requiring the customer to pay a fixed charge plus an energy charge, it was decided to hold him to a minimum monthly bill which would be high enough to net the Company the required revenue.

Let

 $SI_1 = \text{Company Investment in System Extension per Customer}$
 $SI_2 = \text{Customer's Deposit toward System Extension per Customer}$
 $SI = SI_1 + SI_2$
 $AFC = \text{Annual fixed costs}$
 $= 16\% SI_1 + 8\% SI_2$
 $MFC = \text{Monthly fixed costs}$
 $= AFC \times 1/12$

If the average rate charged for energy is 9c per kilowatt-hour and the average increment production cost of energy is 1c per kilowatt-hour, then there is 8c per kilowatt-hour available to meet these costs. Thus if MFC is divided by 8c the necessary kilowatt-hours to be sold is obtained and if these kilowatt-hours are multiplied by 9c the necessary revenue to meet the fixed costs is obtained. This may be expressed as—

 $MMB = \text{Minimum Monthly Bill}$
 $= (16\% SI_1 \div 8\% SI_2) 9/8 \times 1/12$
 $= 0.015 SI_1 \div 0.0075 SI_2$

That is to say, an extension will be made for any customer who will pay the Minimum Monthly Bill and make a deposit in accordance with this formula. Thus if a given extension costs \$600 and the customer is willing to deposit \$200 toward the cost of the extension, his Minimum Monthly Bill shall be—

 $MMB = 0.015 \times \$400 \div 0.0075 \times \200

If the customer makes no deposit, SI_2 becomes zero and the formula is simply—

 $MMB = 0.015 SI$

Since this formula is based on the assumed average cost of \$1600 per mile, the Minimum Monthly Bill, or deposit necessary for any customer, can be computed on the basis of the number of miles of extension necessary to serve him.

By dividing \$1600 by various numbers of customers per mile a series of Minimum Monthly Bills and of customer's deposits have been computed and they are shown in the table below. Thus it is shown in the table that where there are, say, an average of five customers per mile, each customer has his option of having a minimum bill of \$4.80 and making no deposit, or a minimum bill of \$4.00 and a deposit of \$107, or a minimum bill of \$3.00 and a deposit of \$240.

For the purpose of applying these rules the term "customer index" has been coined, which is simply the reciprocal of customers per mile. Thus a customer who requires an extension of 0.125 miles is at the rate of 8 per mile and his index is said to be 0.125 miles. Consider Fig. 1.

CASE I. Suppose farmer A requests an extension from the origin* to his farm. The necessary length of extension will be 0.2 mile. Let us call this number the customer's exact index.

*Point at which an extension begins.

TABLE I

Customer Index	Customers per Mile	Minimum Monthly Bill	Customer's Deposit
0.125 mi.	8	\$3.00	\$ 0.00
0.143	7	3.43	0.00
		3.00	59.00
0.167	6	4.00	0.00
		3.00	133.00
0.182	5.5	4.36	0.00
		4.00	50.00
		3.00	183.00
0.200	5	4.80	0.00
		4.00	107.00
		3.00	240.00
0.222	4.5	5.33	0.00
		5.00	45.00
		4.00	179.00
		3.00	312.00
0.250	4	6.00	0.00
		5.00	133.00
		4.00	267.00
		3.00	400.00
0.286	3.5	6.85	0.00
		6.00	113.00
		5.00	247.00
		4.00	380.00
		3.43	457.00
0.334	3	8.00	0.00
		7.00	133.00
		6.00	267.00
		5.00	400.00
		4.00	533.00
0.400	2.5	9.60	0.00
		8.00	213.00
		7.00	347.00
		6.00	480.00
		4.80	640.00
0.500	2	12.00	0.00
		10.00	267.00
		8.00	534.00
		6.00	800.00

CASE II. After A has helped finance an extension from the origin to his farm, B comes around and wants an additional extension of 0.1 mile to serve him. It is unfair to A to let B benefit disproportionately from A's extension, so while B's exact index is 0.1 mile when he and A are averaged they each have relative indices of $0.3 \div 2$ or 0.15 mile. Thus B shares the burden with A since he benefits by A's extension.

CASE III. If C now applies for an extension he will have an exact index of 0.3 mile and A B & C would have relative indices of $0.6 \div 3$ or 0.2 mile. This would raise the present index of 0.15 mile which A & B now have, but since they benefit in no wise by C's extension they should not

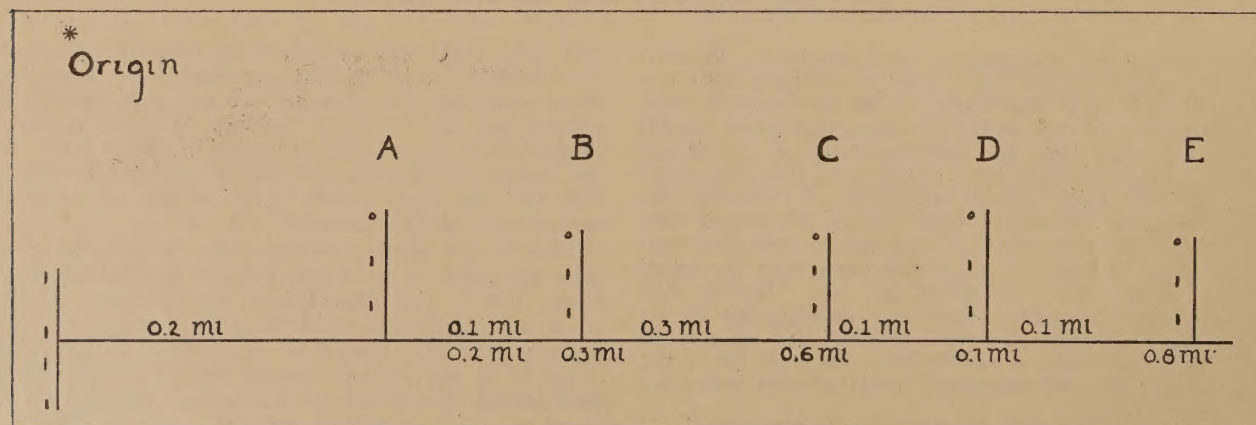


FIG. 1

be made to share it with him and the terms of C's extension are then based on his exact index of 0.3 mile. The end of B's extension might then be called suborigin No. 1 because it is there where C's exact index starts.

CASE IV. Suppose now farmer D, 0.1 mile beyond C, requests an extension. His exact index is 0.1 mile; his relative index to suborigin No. 1 is 0.2 miles and his relative index to the origin is $0.7 \div 4$ or 0.175 miles. To average him way back to the origin will not lower A's and B's index, but to average him with C will lower C's; therefore, C and D will have relative indices of 0.2 mile, while A and B will still have indices of 0.15 mile.

In short, the principle is this—a new customer will be averaged in with one or more other present customers on the line when by so doing their indices remain the same or are lowered. In no case will a new customer raise the index of a present customer.

Customers between points of origin (i.e., suborigin No. 1 and suborigin No. 2, etc.) will have the same index.

Customers may come on and off the line during the year and on December 31 of each year the correct indices for all existing rural customers shall be determined. The exact or relative index shall be used, whichever applies, and then from the table the minimum bills and deposits applying to that customer can be determined.

Table I shows that if a customer has an index of 0.125 or less his minimum monthly bill shall be not less than \$3.00 and he shall be required to make no cash deposit. However, if his index is greater than 0.125, he may make a deposit at his option as shown by the table.

Any deposit made by a customer is subject to refund within four years, as follows:

1. If additional customers come on the line, lowering this customer's index, on December 31 next succeeding, this customer's correct index shall be computed and his deposit shall be partially or wholly refunded to him, depending upon whether or not his new index requires a deposit.
2. If, after first taking service, the customer decides he is willing to have a higher monthly bill, he selects a certain bill from the table and the appropriate refund is made on his deposit.

Under the present application of these rules the rates in general for service in rural territory are the same as those applying in the urban center from which the extension originates. Thus a farmer might have one or more meters, depending upon the number of classes of service he used. There is, for instance, one rate for commercial lighting, another rate for domestic heating and refrigeration, an-

other rate for retail power, etc. All of these rates are block rates but have slightly different scales. Under the commercial lighting rate the customer's minimum bill shall be not less than \$1 per month; under the retail power rate \$1 per horsepower, but not less than \$2, and for domestic heating and refrigeration 40c per kw. but not less than \$2 per month. Thus a customer's index referred to the table gives a certain minimum monthly bill and the sum of the customer's minimum monthly bills on his various meters shall not be less than the minimum as given by Table I.

Fig. 2 shows a typical form for keeping a record of the customer's deposit, with some typical cases worked out.

CASE I. The customer has an index of 0.25 miles and since he does not want to pay more than \$4 month he must deposit \$267 as given by table. The following month he applies for service under classification No. 4 in addition to classification No. 1. According to his connected load his minimum on classification No. 4 is \$3 and, since he found he was already using about \$3/mo. on his lighting, he chose to have a \$6 minimum and a refund of his deposit. This refund should be made December 31 of that year.

CASE II. The customer has an index of 0.20 miles and elects a \$4 minimum monthly bill with a deposit of \$107. The following month he takes two more service classifications giving him a total minimum monthly bill of \$7. Since this is greater than \$4.80 as specified by the table, on December 31 of that year his deposit is refunded to him.

CASE III. This starts off like Case I. The next month the customer takes service under classification No. 4 with a minimum monthly bill of \$3 on classification No. 4 and \$1.00 on classification No. 1 as specified by the classifications. On December 31 of that year it is found that other customers have come on, lowering his index to 0.20 miles. On this basis he is refunded \$160.00. At the end of the fourth year no further change has occurred and the balance of \$107.00 is transferred on the Company's books to contributed property.

Reference was made above to the average rate for energy being 9c per kilowatt-hour. This was determined from the special block rate for farm service or Farm Service Classification, which was designed along with the method for making extensions. This rate is now in use in only one of the Company's districts, but will ultimately be used throughout its territory. It provides for each customer's entire use of service being taken through one meter.

This method for making rural extensions has been approved by the New York State Public Service Commission and has been in operation several months. Thus far it has proved to be very adaptive and very satisfactory to farm

NAME.....Account No.....

ADDRESS.....System Extension.....

Date		Remarks	Customer Index	Minimum Monthly Bill					Refunds	Balance
Mo.	Yr.			Table	Service Classification					
					1	4	5	Deposits		
6	23	.....	\$0.25	\$4.00	\$4.00	.....	.....	\$267.00	.....	\$267.00
12	23	Class No. 4 7/23.....	0.25	6.00	3.00	\$6.00	.....	.....	\$267.00	.....
6	23	.....	0.20	4.00	4.00	.....	.....	107.00	.....	107.00
12	23	Class 4 and 5 7/23.....	0.20	4.80	1.00	3.00	\$3.00	.....	107.00	.....
6	23	.....	0.25	4.00	4.00	.....	.....	267.00	.....	267.00
7	23	.....	0.25	4.00	1.00	3.00	.....	.....	.....	267.00
12	23	.....	0.20	4.00	1.00	3.00	.....	.....	160.00	107.00
12	24	.....	0.20	4.00	1.00	3.00	.....	.....	.....	107.00
12	25	.....	0.20	4.00	1.00	3.00	.....	.....	.....	107.00
12	26	.....	0.20	4.00	1.00	3.00	.....	.....	.....	107.00
12	27	Bal. transferred to contributed property.....	0.20	4.00	1.00	3.00	.....	.....	107.00	.....

FIG. 2—THREE TYPICAL CASES ARE ILLUSTRATED ON THIS SHEET.

customers. Several farmers who heretofore seemed economically out of reach have signed up for a ten, twelve or sixteen dollars per month minimum bill and are now being served. On many existing lines whereon a minimum of three or four dollars applies the customer's average use is about six or eight dollars per month, thus supplying additional revenue with which to meet commercial and other expenses.

The plan outlined above makes available tools with which

to go ahead with the general extension of service to farm customers and it is the function of the newly organized Rural Extension and Farm Service Division of the Commercial Department to promote the adaptation of this service to more and more farm purposes. Numerous experiments and demonstrations with portable power outfits are now being conducted and extensive plans have been made for general rural electrification.

APPENDIX B

RURAL SERVICE PLAN, OHIO PUBLIC SERVICE COMPANY, CLEVELAND, OHIO

P. U. C. O. No. 1

The Ohio Public Service Co., Cleveland, Ohio

Second Revised Sheet No. 1

Cancelling First Revised Sheet No. 1

Rural Service Schedule

Available to any rural customer who desires electric service for lighting, cooking and small power purposes.

RATE (Two Charges)

1. A Readiness-to-Serve Charge—

For all customers for whom a 10 ampere, 110 volt meter is of sufficient capacity, per meter per month.....\$2.00

For all customers for whom larger meters are necessary, the above charge shall be increased for each additional 5 ampere, 110 volt equivalent of meter capacity.....\$0.60
Plus

2. A Consumption Charge—

For the first 50 K.W.H. metered per month, per K.W.H.5c
For all additional energy per K.W.H.3c

DISCOUNT

None.

The above net rates apply only in case the bill is paid within ten (10) days from date of same. If not so paid the gross rates, which are the above rates plus ten per cent (10%), then apply.

SPECIAL RULES

1. Rural Customer and Rural Extension Defined—

The term "Rural Customer" as herein used refers to the consumer of electrical energy who is located outside of the corporate limits of any city or village, or beyond the limits of the local distribution system of any city or village when the same extends beyond the actual corporate limits.

The term "Rural Extension" relates to extensions made primarily to serve rural customers.

2. Analysis of Extension—

Upon application by one or more prospective rural customers, the company will make a survey of the territory in which applicants are located and prepare an estimate of the cost of general and local equipment necessary to supply the service desired.

3. Construction Cost—

Construction cost shall be made up of the cost of "General Equipment" and the cost of "Local Equipment."

(a) General Equipment—

The cost of General Equipment shall include all labor and material, freight, cartage, purchasing and storeroom expense, chargeable to the rural extension from the point of origin to the end of same. When step-up transformers are required, the cost of same, together with the cost of all auxiliary and protective devices will be included.

To the above item of cost will be added ten per cent, to cover contingent expenses, cost of accounting and other items, the cost of which cannot be accurately estimated; and a second item of ten per cent, to cover Engineering, Supervision and the use of tools.

(b) Local Equipment—

The cost of Local Equipment will include all labor and material, freight, cartage, purchasing and storeroom expense required for the installation of step-down transformers, secondary mains, service connections, protective devices and other detail equipment required to serve each customer or group of customers.

To the above will be added two items of ten per cent, each as defined in the preceding paragraph to cover Contingencies and Engineering and Supervision.

(c)

Metering equipment will be supplied and installed by the company at its own expense. Customer is to provide proper and satisfactory meter location and to provide meter loops in accordance with the requirements of the company.

(d)

The cost of Local Equipment is separated from the cost of General Equipment in order that the cost of the extension as a whole may be equitably distributed among customers of varying size.

4. Payment by Customer—

The customers to be served from any rural extension shall collectively deposit with the company an amount equal to the estimated cost of the general equipment to be furnished and, in addition thereto, each individual customer or group of customers shall deposit with the company the estimated cost of the local equipment necessary to serve him or them.

Upon the deposit of the funds provided for in the preceding paragraph, the construction work will be completed and service supplied as soon as practicable.

5. Title to Property—

Notwithstanding any payments made by customers to the company covering the cost of general or local equipment, the title to the same shall be and remain in the company.

6. Connection Charge for Additional Customer—

An additional rural customer will be connected to an extension only upon the payment of a connection charge plus a local equipment charge.

The connection charge for each separate extension shall be determined by dividing the total cost of the "General Equipment" by the number of customers connected thereto at the time of the application by the additional customer.

The local equipment charge for each separate group shall be determined by dividing the total cost of the local equipment by the number of customers connected thereto at the time of the application by the additional customer in that group.

If the additional cost of the general equipment required to serve the additional customer is less than the connection charge, the additional customer shall pay the connection charge and the local equipment charge, whereupon the company will make the connection. The difference between

the connection charge and the additional cost of general equipment shall be refunded to the customers on the extension (including the additional customer) in proportion to the amount each has on deposit with the company, for general equipment as of that date.

If the additional customer is served from local equipment already installed to supply a group of customers and if the additional cost of the local equipment required to serve the additional customer is less than the local equipment charge, the difference between the local equipment charge and the additional cost of local equipment shall be refunded to the customers in such group (including the additional customer) in proportion to the amount each has on deposit with the company for local equipment as of that date.

If the additional cost of the general equipment required to serve the additional customer is greater than the connection charge determined as above, the additional customer shall pay the cost of additional general equipment. If the additional cost of the local equipment required to serve the additional customer is greater than the local equipment charge, determined as above, the additional customer shall pay the cost of additional local equipment, whereupon the company shall make the connection. In such cases, no refunds will be made to the original customers.

After the expiration of five years from the time each extension is first put in service, the company may connect additional customers upon the payment of the actual cost of the general and local equipment necessary to serve them. The company shall not be obligated to make any refund to existing customers under such conditions.

7. Change of Capacity—

When the capacity, size or character of any General or Local Equipment is required to be increased or changed in order to adequately take care of the rural service, the customer or prospective customer whose requirements necessitate the change shall pay the entire cost of same. The apportionment of such payments shall be the same as outlined in Section No. 6.

8. Combined Transmission Line and Rural Extension—

In case the rural extension is constructed for use partly as a transmission line for some large customer or municipality and the revenue to be derived from the use of the extension as a transmission line is inadequate to justify the construction of the extension without a portion of the cost being paid by rural customers, such portions of the cost of general equipment as may equitably be apportioned to the rural business shall be paid for by prospective rural customers. Rural customers shall, in all cases, pay for local equipment.

9. Continuity of Service—

The customer understands and agrees that service shall be furnished from a single line and that service may be

interrupted from time to time due to accident or the making of repairs. The company will use reasonable diligence in furnishing an uninterrupted and regular supply of electrical energy.

10. Access to Customers' Premises—

The company shall have the right at all times to make an examination of the apparatus and materials placed by it on the premises of the customer and to make such changes and improvements as shall, in its opinion, be necessary for the proper operation of the installation at such times as may be mutually agreed upon.

11. Inspection of Installation—

The company shall have the right at all times to inspect the equipment of the customer and it may refuse to make connection or give service unless customer's installation is in proper condition to receive and to utilize the same. The customer shall make no changes in his installation which may harmfully affect the operation of the company's equipment or its service to others.

12. Default—

If the customer defaults in payment of bills or fails to comply with the company's rules after due notice has been given, the company may disconnect service and remove its metering equipment.

13. City Rules—

Rules applying to city service, except as herein modified, shall also apply specifically to rural service.

14. Term of Contract—

Service shall be supplied hereunder for a period of one (1) year and thereafter until terminated by thirty (30) days' written notice from either party to the other, except as otherwise provided in the company's General Service Rules and Regulations.

15. Reconnection Charge—

If service is discontinued to any customer it will not be reconnected at the same address and for the same customer except upon payment of a reconnection charge of ten dollars (\$10.00).

By "customer" in this clause is meant the occupant of the premises or any member of his family.

Issued Dec. 1, 1925

Effective Jan. 1, 1926

T. O. Kennedy, General Manager
Cleveland, Ohio

APPENDIX C

A PLAN OF SUPPLYING RURAL ELECTRIC SERVICE OF THE IOWA RAILWAY AND LIGHT COMPANY, CEDAR RAPIDS, IOWA

Form No. C-82.
Jan. 20, 1925.

INDIVIDUAL RURAL ELECTRIC SERVICE CONTRACT

(COMPANY OWNERSHIP OF THE RURAL DISTRIBUTION SYSTEM)

(Service Limited to a Single Phase and a 5 kv-a Transformer)

MEMORANDUM OF AGREEMENT made this
day of _____, A. D. 192____, by and
between the IOWA RAILWAY AND LIGHT COM-

PANY, an Iowa Corporation hereinafter called the "PRODUCER", and
the owner of the land hereinafter described, and who is
hereinafter called the "OWNER",

WITNESSETH: That for and in consideration of the
agreements of the parties hereto, hereinafter set forth, and
the performance of said agreements, it is mutually understood
and agreed by and between said parties as follows:

1. The PRODUCER shall finance, own, construct, maintain, and operate a rural distribution line of such capacity as may be necessary to satisfactorily serve, with electricity,

the property (the title of which is hereby affirmed by the OWNER to be in his name) described as follows:

The said rural line begins, or shall begin, at

, and

shall be located on the highway which passes along the _____ feet of the _____ line of the above described property, and is, or shall be, designated in the PRODUCER'S records as the Rural Line.

2. The PRODUCER shall finance, own, install, maintain, and operate the transformers, meters, and service lines required to satisfactorily serve with electricity, the said property of the OWNER from the meter loop which is to be located in the _____ as lo-

cated at the date of this agreement.

3. The PRODUCER shall furnish electric service, and the OWNER shall use and pay for such service in accordance with the terms and conditions of this agreement and the Rules and Regulations of the PRODUCER. The Rules and Regulations effective at the date of this agreement are on the back hereof.

4. The PRODUCER shall charge and the OWNER shall pay for the service furnished under this agreement as follows:

a. A Monthly Charge of _____ (\$ _____)

NOTE. The Monthly Charge is composed of Items (a), (b), (c), (d) and (e) of Article One (1) Rate No. 61, Form No. R-200, Effective Jan. 15, 1925, receipt of a copy of which is hereby acknowledged by the OWNER. The charge is based on a service line _____ feet long, a _____ Kilovolt ampere transformer, the Demand Miles specified in Article Fourteen (14) hereof, and a Monthly Billing Demand of _____ kilowatts. The service will be single phase, 60 cycles per second, 110/220 volts.

b. An Electricity Base Rate of two and 9/10 cents (2.9c.) per kilowatt hour for all electricity used in a month.

c. The Charge and Rate are net. Bills not paid within ten days after rendition shall be increased ten per cent (10%) on the first ten dollars (\$10.00) and two per cent (2%) on amounts in excess of the first ten dollars.

d. The Electricity Base Rate will be increased or decreased beginning with each fiscal year, at the rate of one mill per kilowatt hour for each fifty cents (50c.) (or major part thereof) variation in the Energy Cost per ton from a Base Energy Cost of four and 50/100 dollars (\$4.50) per ton of 10,000 B.t.u. fuel burned during the previous fiscal year. The Energy Cost per ton of fuel burned shall be obtained by dividing the total Fuel, Boiler Room Labor and Water (for boilers) Expenses by the number of tons of fuel burned in the Company's steam electric plants. A fiscal year is the period from April 1st to March 31st. Should the quality of the fuel burned vary from 10,000 B.t.u. the Base Energy Cost shall be varied in proportion as the fuel burned varies from 10,000 B.t.u.

5. The Monthly Charge given in Article Four (4) Item (a) hereof shall, except as herein provided, be revised by the PRODUCER when the Demand Miles designed in Article Fourteen (14) hereof may change, when the transformer requirements and Monthly Billing Demand change, or authoritative diversity factor data as provided in Note under Item (e) Article 1 Rate No. 61 Form No. R-200 Effective Jan. 15, 1925, has been established. Revision shall be made only at the beginning of the first billing

month which is thirty days after the date of the Rider that shall be furnished the OWNER showing the revised Monthly Charge and the changed conditions. The revisions shall be made in accordance with the PRODUCER'S schedule of Charges and Rates as contained in Rate No. 61, Form No. R-200, Effective Jan. 15, 1925.

6. In the event electric service is not required, or is abandoned on the property described in Article One (1) hereof, or the transformer, service line, and meter have not been installed, or have been removed or ordered removed, the OWNER shall not, before the installation of said transformer, etc., or after the removal thereof, be liable for the payment of any of the Charges and Rates as herein provided, except the Monthly Charge for the distribution line as determined in Article One (1) Item (d) of the PRODUCER'S Schedule of Charges and Rates as contained in Rate No. 61, Form No. R-200, Effective Jan. 15, 1925. The liability of the OWNER, for the said distribution line charge shall cease only after another person, contiguous to the rural line designated in Article One (1) hereof, shall contract for electric service under the same terms as set forth in this agreement, or any amendments thereto as may be evidenced by Riders.

7. The PRODUCER shall not serve any other OWNER from the rural line designated in Article One (1) hereof who requires an extension thereto in excess of the number of feet found by dividing five thousand two hundred and eighty feet by the Demand Miles upon which the charges are based at the time of the application of such extension, unless the extra cost is assumed by the OWNERS who are to be served from the proposed extension. Where a rural line having different Demand Miles and a different designation from the line described in Article One (1) hereof originates from the said line, the Monthly Billing Demands of the OWNERS on such differently designated line shall not be used in determining the Demand Miles of the line described in Article One (1) hereof.

8. The PRODUCER will, upon written request of the OWNER, render bills for the monthly electric service to a tenant of the property described in Article One (1) hereof, as such tenant continues to make payments of when due; but such billing shall only be for the use of the OWNER and shall in no way relieve the OWNER of the obligation to pay such bills.

9. The failure of either of the parties hereto to enforce, from time to time, the strict performance of any of the covenants and agreements herein contained, or the waiving from time to time of a default on the part of either of the parties hereto, shall not be construed as a waiver of any continuing or subsequent default, or defaults, nor impair the right of either of the parties hereto subsequently to require the strict performance of each and every covenant, agreement and undertaking herein contained.

10. The PRODUCER shall have the right to erect, where necessary, the said rural distribution lines on the property described herein, along the highway line, and to do the necessary pruning of trees along the property and to do other things essential to the efficient and safe operation of the said rural distribution lines, and to enter upon the said property for the purpose of such erection and for the installation, maintenance, operation and removal of any or all of the equipment specified in Articles One (1), Two (2), and Ten (10) hereof, and the necessary appurtenances thereto.

11. The OWNER shall not be relieved of any of the obligations hereof by transferring title of the property described in Article One (1) hereof unless the grantee of the OWNER has entered into an agreement for the service.

12. The Rules and Regulations, and Charges and Rates of the PRODUCER affecting the OWNER may be revised by mutual consent of the PRODUCER and a majority of the OWNERS served from said Rural Line. In the event that the PRODUCER or a majority of the OWNERS shall,

by written notice, request a revision of said Rules and Regulations and Charges and Rates, and such revision shall not have been effected by agreement within sixty (60) days after the date of said written notice, either party may submit the matter to any legally authorized body having jurisdiction in the premises.

13. This agreement shall commence on the _____ day of _____, 192____, and end on the _____ day of _____, 19____, unless terminated as provided in Article Six (6) hereof, or by a shorter life of the distribution line.

14. This agreement made in duplicate shall be binding upon the OWNER only after the kilowatt demands per mile, or Demand Miles of the said Rural Distribution line, is equal to or greater than _____ (____), and shall be binding upon the PRODUCER only after its execution by a General Officer of the PRODUCER. Signed in duplicate this _____ day of _____, 192____.

IOWA RAILWAY AND LIGHT COMPANY,
Producer

Owner

Attest:

Secretary.

RULES AND REGULATIONS

- Installation and Maintenance of Owner's Wiring, Equipment, and Apparatus**
All wiring, equipment and apparatus must be installed and maintained in accordance with the legally authorized code.
- Protection of Service**
The PRODUCER'S service shall not be used for operating wireless equipment or other equipment that will affect the service of the PRODUCER, without complying with the PRODUCER'S rules governing such equipment.
- Testing and Removal of Meters**
The PRODUCER'S agents shall be allowed to enter the OWNER'S premises at reasonable times to read, test or remove the meters.
- Meter Loop**
Owners shall furnish and install the meter loop and cutout in accordance with the specifications of the PRODUCER.
- Charges for Reconnection of Service**
The first connection of a service for an OWNER is covered in the Charges and Rates, but a charge of \$2.50 will be made for each reconnection at the same location.
- Correcting Meter Errors**
In case a meter is found to be incorrect by more than 2 per cent the consumption for the two billing months preceding the test shall be adjusted to conform to the correct amount based on said test.
- Stopped Meters**
Should a meter fail to register during all or part of a month, the bill for the month shall be calculated equitably from the previous or succeeding month's consumption, or from known load and hours of consumption.
- Reading Meters**
The PRODUCER will read meters on or about the same day each calendar month; except in cases where it elects to furnish the OWNER with stamped and addressed meter cards, in which case the OWNER shall mark the position of the meter dial hands as they exist at such times as the PRODUCER may request, and mail the card promptly to the PRODUCER.
- Rendition of Bills**
The PRODUCER will render a bill or bills to the OWNER or the tenant upon written request by the OWNER for electricity and such other services as may be due the PRODUCER on or about the same day of each calendar month. Rendition of a bill shall be the mailing or delivery of the bills to the address designated by the OWNER or tenant.
- Non-Payment of Bills**
In the event all of the money due the PRODUCER for electric service has not been paid within twenty days after rendition of a bill or bills, the PRODUCER shall have the right to discontinue service until all amounts in arrears are paid in full.
- Continuity of Service**
The PRODUCER will use due diligence to furnish continuous and uninterrupted service, but the PRODUCER shall not be liable for damages caused by any interruption of service.

File No.....

INDIVIDUAL FARM CONTRACT

(Company Ownership of Lines)

BETWEEN

Iowa Railway and Light Company

AND

Town..... Division.....

Signed and dated, 19..

Accepted, 19..

Effective

Term

Rate

Commences, 19..

Expires, 19..

Line built by.....

Inspected by

Copy contract with

Copy contract with

Insurance Department Endorsement

REMARKS:

FIG. 3—FACE OF CONTRACT, IOWA RAILWAY & LIGHT CO.

Form No. R-200.
Jan. 20, 1925.

IOWA RAILWAY AND LIGHT COMPANY

Rate No. 61

APPLICABLE TO RURAL ELECTRIC SERVICE FROM
A RURAL DISTRIBUTION SYSTEM FINANCED,
OWNED, MAINTAINED, AND OPERATED BY THE
COMPANY

Available for Rural Consumers (Owners) Who Can Be
Served with a Transformer of 5 kv-a. or Less, Rated Capacity.

1. A Monthly Charge made up of the following items:

Item a. Sixty cents (60c.) to cover the meter expenses, billing, etc.

Item b. A Service Line Charge of one-half cent (0.5c.) per foot of service line measured from the center of the highway, when the Rural Distribution Line is located on a highway, or from the said line, when located on a Right of Way owned by the Company. A service line shall consist of the wires, poles and other necessary accessories, connecting the Company's rural distribution line with the Consumer's meter loop, whether the transformer is located on the Company's rural distribution line or on the Consumer's property.

Item c. A transformer charge obtained from Table 1

for the size of the transformer that would be provided if the Consumer were to be served by a separate transformer, except that when two or more consumers are served by one transformer, and the entire cost of the secondary wiring is covered in the Consumer's Service Line Charge, the Transformer Charge for the size of the transformer used shall be apportioned between them by the ratio that the Monthly Billing Demand of each bears to the sum of the Monthly Billing Demands of those served from the transformer.

Table 1

SIZE Kv-a.	AMOUNT
1½	\$3.10
3	3.40
5	3.90

Item d. A Pole Line charge determined by multiplying the Consumer's Monthly Billing Demand by the value obtained from Formula 1 for the Demand Miles of the line, except that during those months in which the meter, transformer and service line may not be installed, fifty cents (50c.) per kilowatt of Monthly Billing Demand shall be added to the said Pole Line Charge. If the service line is installed the amount shall be increased by the amount of the Service Line Charge, Item (b).

Formula 1

The charge for the Demand Miles of a line will be determined as follows:

1. Obtain the product of fifty cents (50c.) and the Demand Miles of the line.
2. Obtain the remainder found by subtracting the product (1) from \$15.00.
3. Divide the remainder (2) by the Demand Miles of the line, the quotient is the Monthly Charge for the Demand Miles.

Note: The Demand Miles will be the sum of the Monthly Billing Demands of consumers served by the line divided by the number of miles of line. The Monthly Billing Demand of a consumer served by the line will be determined as follows:

1 kilowatt for each rural consumer having no device larger than 750 watts.

1½ kilowatts for each rural consumer having a device larger than 750 watts but not exceeding 2½ kilowatts.

2 kilowatts for each rural consumer having a device larger than 2½ kilowatts but not exceeding 6 kilowatts.

2½ kilowatts for each rural consumer having a device larger than 6 kilowatts but not requiring a transformer in excess of 5 kv-a.

640 watts for each residence consumer, in a settlement or town supplied from the line, having no device larger than 750 watts.

1.7 kilowatts for each residence consumer, in a settlement or town supplied from the line, having a device larger than 750 watts, but not exceeding 6 kilowatts.

2 kilowatts for each residence consumer, in a settlement or town supplied from the line, having a device larger than

6 kilowatts but not requiring a transformer in excess of 5 kv-a.

85 per cent of the Monthly Billing Demand, based on a kilowatt at 100 per cent power factor, of each commercial light and power consumer, in a settlement or town supplied from the line, who does not require a transformer in excess of 5 kv-a.

70 per cent of the Monthly Billing Demand, based on a kilowatt at 100 per cent power factor, of any consumer supplied from the line who requires transformer capacity in excess of 5 kv-a.

Item e. A Demand Charge as follows:

Monthly Billing Demand	The Demand Charge Per Month
1 kilowatt where no device exceeding 750 watts is installed	\$1.00
1½ kilowatts where a device larger than 750 watts but not exceeding 2½ kilowatts is installed	1.50
2 kilowatts where a device larger than 2½ kilowatts but not exceeding 6 kilowatts is installed	2.00
2½ kilowatts where a device larger than 6 kilowatts but not requiring a transformer larger than 5 kv-a. is installed	2.50

Note: The Demand Charges and the Monthly Billing Demand as above determined and the Monthly Billing Demands as determined in Item d are tentative values and are subject to revision when authoritative diversity factor data are available.

2. An Electricity Base Rate of two and nine-tenth cents (2.9c.) per kilowatt hour for all electricity used in a month.

3. The Charges and Rate are net. Bills not paid within ten days after rendition shall be increased 10 per cent (10%) on the first ten dollars (\$10.00) and 2 per cent (2%) on amounts in excess of the first ten dollars.

4. The Electricity Base Rate will be increased or decreased beginning with each fiscal year at the rate of one mill per kilowatt hour for each fifty cents (50c.) (or major part thereof) variation in the Energy Cost per ton from a Base Energy Cost of four and 50/100 dollars (\$4.50) per ton of 10,000 B.t.u. fuel burned during the previous fiscal year. The Energy Cost per ton of fuel burned shall be obtained by dividing the total Fuel, Boiler Room Labor and Water (for boilers) Expenses by the number of tons of fuel burned in the Company's steam electric plants. A fiscal year is the period from April 1 to March 31. Should the quality of the fuel burned vary from 10,000 B.t.u., the Base Energy Cost shall be varied in proportion as the fuel burned varies from 10,000 B.t.u.

5. Those desiring service under these rates will be expected to sign Contract Form No. C-82.

Issued Jan. 15, 1925.

Effective Jan. 15, 1925.

Issued by

SUTHERLAND DOANE,
General Manager.

APPENDIX D

A PLAN FOR SUPPLYING RURAL ELECTRIC SERVICE OF THE WISCONSIN POWER AND LIGHT COMPANY, MADISON, WISCONSIN

CONTRACT FOR RURAL ELECTRIC SERVICE

MEMORANDUM OF AGREEMENT, made thisday of192.., by and between the Wisconsin Power and Light Company, party of the first part, hereinafter called the "Company," and Owner of the premises hereinafter described, party of the second part, hereinafter called the "Customer."

WITNESSETH: That for and in consideration of the

agreements of the parties hereto, as hereinafter set forth, and the performance of said agreements, it is mutually understood and agreed by and between the parties as follows:

1. The Company agrees to construct, maintain, operate and own a rural electric extension, including transformer, line protective devices, service line, and meter, of such capacity as may be necessary to supply electric energy to the Customer. Said energy shall be available for the

Customer's use at his located and described as follows:

2. The Company agrees to pay all the costs of construction of said rural extension up to an average of \$400.00 for each customer served by said rural extension.
3. The Customer agrees to pay to the Company the amount, if any, by which the average construction cost per customer exceeds \$400.00. This amount is now estimated to be
4. The Company agrees to furnish electric service and the Customer agrees to use and pay for such service in accordance with the terms and conditions of this agreement and the Rules and Regulations of the Company. Electric service furnished under this contract is for use on the premises described herein. The Customer agrees not to resell or otherwise dispose of same, except to a tenant of said premises, without the written consent of the Company.
5. The Company agrees to charge and the Customer agrees to pay a monthly service charge plus an energy charge as follows:

(a) Service Charge:

<i>Transfer Capacity Required</i>	<i>Monthly Service Charge</i>
Not more than 1½ kv-a.....	\$5.50
Over 1½ kv-a. and not more than 3 kv-a..	6.00
Over 3 kv-a. and not more than 5 kv-a..	6.60
Over 5 kv-a. and not more than 7½ kv-a..	7.25
Over 7½ kv-a. and not more than 10 kv-a..	8.00

Provided that, where three or more customers are served from one transformer, the above service charges may be reduced in accordance with Rule 11 attached hereto.

(b) Energy Charge:

For the first 30 kw-hr. used per mo.... 5½¢. per kw-hr.
For all in excess of 30 kw-hr. used per mo. 3½¢. per kw-hr.

A discount of ½¢. per kw-hr. will be allowed on the energy portion of any bill paid within fourteen days from the date of the bill.

The service charge shall constitute the minimum monthly bill.

6. In consideration of the investment made by the Company and of the fact that economical service depends upon liberal use of current, the Customer agrees to exercise ONE of the following options:
EITHER (a) To secure, within eighteen months from the date of this contract, for regular use on the premises described herein, electrical equipment of a value (exclusive of wiring and installation costs) approximating the Company's average investment per Customer in the rural extension used to serve the Customer.
OR (b) To secure, within eighteen months from the date of this contract, for regular use on the premises described herein, electrical equipment having a total wattage of at least 4000 watts, motors to be reckoned at 1000 watts per rated horsepower.
OR (c) To use during the second and all subsequent calendar years of service, not less than 1200 kilowatt hours of electric energy per year.
7. The failure of either of the parties hereto to enforce, from time to time, the strict performance of any of the covenants and agreements herein contained, or the waiving from time to time of a default on the part of either of the parties hereto, shall not be construed as a waiver of any continuing or subsequent defaults, nor impair the right of either of the parties hereto subsequently to require the strict performance of each and every covenant, agreement and undertaking herein contained.
8. The Customer agrees to permit the Company to erect,

where necessary, the said rural distribution line on the highway along the property described herein and from the highway to a suitable distribution center on the Customer's premises, to do the necessary pruning of trees, to set anchors where necessary, and to do other things essential to the efficient and safe operation of the said rural distribution line, and to enter upon the said property for the purpose of such erection and for the installation, maintenance, operation and removal of any or all of the equipment specified in Paragraph One (1) hereof, and the necessary appurtenances thereto.

In exercising these rights, the Company shall give due consideration to the wishes of the Customer in preserving the appearance and value of the property.

In the event that the premises described in Paragraph One above are sold, the Customer agrees to convey the same subject to the rights granted to the Company in this Paragraph Eight (8).

9. This agreement shall continue in force for a period of five years, commencing when the Company first furnishes service hereunder, and shall remain in force thereafter from year to year unless and until terminated on or after the expiration of five years, by the Customer giving the Company ninety days' notice in writing of his election to terminate the same.
10. The Company agrees to cancel the service charge for any calendar month, but not exceeding three months in any year, during which the premises described herein are unoccupied because of a change in tenancy.
11. This agreement, including the Rules and Regulations of the Company attached hereto, shall be binding on the parties hereto, their heirs, executors, administrators, successors and assigns, but shall not become effective unless and until similar agreements are signed by enough customers to make the number of customers to be served by the proposed rural extension average not less than per mile.

WISCONSIN POWER AND LIGHT COMPANY

By

Customer

Witnesses:

.....
.....
.....

I, the undersigned, being the occupant of the premises above-described, under a contract between myself and the above-named customer, for value received hereby agree that I will pay to the Company, for the account of the Customer, all bills for electric service which may be furnished by the Company under the above contract during the term of my occupancy of said premises.

Dated

Rules Governing Rural Extensions

1. Intent

These rules are intended to facilitate the securing of electric service in rural communities on such a basis as will stimulate the widespread use of electricity for heat, light and power. In interpreting these rules, a rural extension should, so far as is practicable, be considered a community enterprise from which each individual customer will derive benefit through cooperation with all the other customers.

2. Rural Customer Defined

For the purpose of these rules, a rural customer is defined as a purchaser of electric service (except customers

of a class for which the Company has a suitable urban rate filed with the Railroad Commission) who can be adequately served from one transformer of not more than 10 kv-a. capacity; and who uses the service in the conduct of one enterprise, occupation or institution, located outside the limits of a city or village or community with similar characteristics, at such distance that it cannot be adequately served from the secondary lines of the local distribution system.

A purchaser of electric service, for use at a rural residence which is located outside the limits of a city, village or community with similar characteristics, and which is in all respects a separate family establishment and is not directly connected with the operation of a farm, is expressly exempted from this definition. Such service is hereby designated as rural residence service.

A farm is hereby defined as any area of land from which the occupant derives an appreciable part of his income.

3. Rural Extension Defined

Rural extensions as herein used shall include all extensions to distribution systems built primarily to serve rural customers.

4. Cost of Extension Defined

The construction cost shall include the costs of all materials, and the costs of all labor and other expense required for the distribution and installation of poles, wire, cross arms, insulators, line hardware, switching and protective devices, transformers, meters, appurtenances, right of way permits, etc.

An item not exceeding 10 per cent of material costs shall be included to cover purchasing expense, freight, cartage to storeroom and stores department expense.

An item not exceeding 15 per cent of all above-mentioned costs shall be included to cover general overhead, engineering promotion, office supervision, clerical labor, contingencies, etc.

5. Analysis of Extension

When one or more prospective rural customers make application for electric service, the Company will investigate the extension, ascertain the number of customers who can be advantageously served, the number who will contract for service under the terms herein prescribed and will estimate the construction cost as outlined in Rule 4, provided that, in the opinion of the Company, the extension is justified.

6. Payments by Customers

When the analysis of the proposed rural extension indicates that electric service is justified from both the Company's and the Customer's standpoint, the Company will execute with each prospective rural customer a contract setting forth the rate, terms and conditions of service in substantially the form attached hereto.

If the number of contracts signed is such that the estimated cost of the extension will not exceed an average of \$400.00 per customer, the Company will proceed to construct the extension at its own expense.

If the cost of the extension is estimated to be more than an average of \$400.00 per customer, the amount by which said costs are estimated to exceed said average shall be contributed by the customers. One-half of such contribution shall be paid to the Company when the poles are set and the remainder shall be paid when service is available. The amount of the second payment shall be adjusted on the basis of the actual cost of construction above an average of \$400.00 per customer.

7. Additional Customers

If, within five years from the date when service is first established on a rural extension, additional rural customers are connected to the extension, either directly or by any branch from or addition to the extension, the cost of connecting them will be included in a new determination of the average cost per customer whenever such inclusion will lower the average cost per customer already served by the extension. In such cases the new customers shall pay

to the Company and the Company shall refund to the customers already served such sums as will equalize all the customers' investment in the extension. No such redetermination shall be made as would tend to increase the contribution required from existing customers, but the additional customers shall contribute the amount by which the connection cost exceeds an average of \$400.00 each.

If, within five years from the date when service is first established on a rural extension, an urban customer is connected to the extension at an actual connection cost less than the urban free limit, as defined in the urban rules of the Company, then the difference between such actual cost of connection and the urban free limit shall be refunded to the rural customers served by the extension in proportion to the investment, if any, that each has in the extension.

8. Combined Rural Extension and Transmission Line

In case a rural extension is constructed, for use partly as a transmission line to some large customer, city, village or hamlet, and such use does not justify the cost for that purpose alone, the additional cost may be charged against the rural customers served along the original line, but no contribution shall be required from them unless such additional cost amounts to more than \$400.00 per rural customer. In no such case shall a larger contribution be required than would be required if the extension served the rural customers only.

Any subsequent extension shall be considered by itself.

9. Customers' Investment in Equipment

The success of rural electrification depends upon economical and profitable use of current by the Customer in sufficient quantity to assure a proper return to the Company. Such use of current requires the application of electricity to many farm operations and the use of proper electrical equipment. For this reason each rural customer will be required to exercise *ONE* of the following options:

EITHER (a) To secure, within eighteen months from the date of this contract, for regular use on the premises described herein, electrical equipment of a value (exclusive of wiring and installation costs) approximating the Company's average investment per Customer in the rural extension used to serve the Customer.

OR (b) To secure, within eighteen months from the date of this contract, for regular use on the premises described herein, electrical equipment having a total wattage of at least 4000 watts, motors to be reckoned at 1000 watts per rated horsepower.

OR (c) To use, during the second and all subsequent calendar years of service, not less than 1200 kilowatt hours of electric energy per year.

The electrical equipment mentioned above may include:

Motors for operating pumps, milking machines, cream separators, fanning mills, corn shellers, feed mills, hay hoists, concrete mixers, saws, or other machinery.

Electric Range

Electric Iron

Electric Ironer

Electric Heater

Electric Incubator

Electric Brooder

Electric Washing Machine

Electric Refrigerator or Ice Machine

Electric Drill, or other electrically operated apparatus ordinarily sold as one unit, including the electric feature.

Wiring costs and installation costs of equipment are not to be included in computing the amount of the Customer's investment in such equipment.

In case the required equipment is purchased from the Company, arrangements may be made to pay for the same in not more than twenty-four monthly installments.

10. Rate

Except as hereinafter provided, each rural customer will be required to pay monthly bills consisting of a service charge plus an energy charge, as follows:

(a) Service Charge:

<i>Transformer Capacity Required</i>	<i>Monthly Service Charge</i>
Not more than 1½ kv-a.	\$5.50
Over 1½ kv-a. and not more than 3 kv-a.	6.00
Over 3 kv-a. and not more than 5 kv-a.	6.60
Over 5 kv-a. and not more than 7½ kv-a.	7.25
Over 7½ kv-a. and not more than 10 kv-a.	8.00

(b) Energy Charge:

For the first 30 kw-hr. used per month....5½c. per kw-hr.
 For all in excess of 30 kw-hr. used per month3½c. per kw-hr.
 A discount of ½c. per kw-hr. will be allowed on any bill paid within fourteen days from the date of the bill.

The service charge shall constitute the minimum monthly bill.

11. Two or More Service Lines from Transformer

The rates set forth above are based on one service line and one meter per rural customer.

If two rural customers are served from one transformer, each shall pay the same service charge as though served by a separate transformer.

If more than two rural customers are served from one transformer, each of them will be allowed a discount on his service charge as follows:

<i>Customers Served</i>	<i>Discount on Service Charge, Per Cent</i>
3	20
4	40
5 or more.....	50

Such a group as a whole will be considered equivalent to two rural customers in computing average cost of extension, payments by customers, refunds to customers and required investment in appliances.

In each of the above cases the service charge for each customer will be based on the transformer capacity required adequately to serve him, without regard to the transformer capacity actually installed or the service charges paid by any other customer served from the same transformer.

Where one transformer supplies two or more secondary services to the same customer, whether it be an individual or any form of bonafide partnership, there shall be an additional charge of \$1.00 per month for each such additional service and meter.

All decisions as to the number or size of transformers required will be made by the Company.

12. Public Buildings on Rural Extensions

Public buildings, such as town halls, rural churches and rural public schools, having not more than two rooms, will not be included in computing the construction costs per customer.

If the cost of connecting such buildings does not bring the total cost of the rural extension above an average of \$400.00 for the other rural customers served, the Company will make such connection without charge. But any excess cost above said average which results directly from connecting such public building shall be paid by the town, school district, church organization, or other body responsible for the maintenance of the building.

No service charge will be made to such public building. The regular energy rate will be applied to all monthly consumption with a minimum bill of \$2.00 per month.

13. Rural Residence Service

When application is made for rural residence service from a rural extension which is financed wholly by the Company under these rules, and when the total cost of connecting the residence to such an extension does not exceed \$150.00, then the Company will make such connection at its own expense. The following service charge will apply:

<i>Transformer Capacity Required</i>	<i>Monthly Service Charge</i>
Not more than 1½ kv-a.	\$2.50
Over 1½ kv-a. and not more than 3 kv-a.	3.00
Over 3 kv-a. and not more than 5 kv-a.	3.60

Energy charges and discounts shall be the same as for regular rural customers, except that there shall be no discount from the service charge for rural residence service.

Purchasers of rural residence service will not be counted in computing average cost of extension, payments or refunds. But any such purchaser may elect to secure service in the same manner as a regular customer under these rules.

14. New Customers on Old Extensions

If, within five years from the date when these rules are approved by the Railroad Commission, a new rural customer is connected to and served under these rules from a rural extension built prior to Nov. 1, 1925, under any plan whereby the original or existing customers may receive refunds through the addition of new customers, adjustments will be made as follows:

- If neither the regular connection charge for the extension of the actual cost of connecting the new customer exceeds \$400.00, the Company will make the connection without cost to the customer.
- If either the regular connection charge for the extension or the actual cost of connecting the new customer exceeds \$400.00, the new Customer must contribute the amount by which the larger sum exceeds \$400.00.
- If the actual cost of connecting the new customer is less than the regular connection charge for the extension, then the difference between the two amounts will be applied as a credit toward the original cost of the extension, or as a refund to the rural customers in accordance with the spirit of the agreement under which the extension was built.
- The service charges or rural charges for the other customers served from the same extension will not be affected by such connection or by the revenue derived from such new customer.

15. Continuity of Service

The Company will use reasonable diligence in furnishing an uninterrupted and regular supply of electric energy, but it shall not be liable for interruptions due to accidents or the necessity for repairs.

16. Change in Tenancy

Whenever a farm home is vacated because of a change of ownership or tenancy, the Company will make no service charge for the period, not to exceed three months in any calendar year, during which the home is unoccupied.

17. Urban Rules

The Company's rules applying to urban service, except as herein modified, shall also apply to rural service.

18. Type of Service

The service to be furnished under these rules shall be at 110/220 volts, 60-cycle, single phase.

19. Extensions from High Voltage Lines

Rural extensions from transmission lines of over 15,000 volts may be considered special by the Company.

20. Inspection of Installation

All wiring shall conform to the requirements of the Wisconsin State Electrical Code. The Company reserves the right to inspect the wiring plans and the finished installations of the Customer and may refuse to make connection or give service where the installation is not in proper condition, from the standpoint of safety, permanence or adequacy for prospective loads. The Customer shall not materially increase his load without first notifying the Company and obtaining its consent.

Except by definite consent of the Company, the minimum requirement for service entrance shall be three No. 6 wires.

21. Rates for Villages Excluded

Nothing in these rules shall be deemed to determine the rates for electric service to hamlets, small villages, summer resorts, lake shore cottages or other closely grouped

buildings, service to which is made available by the construction of a rural extension. The rates for such service are expressly reserved for separate consideration and adjustment in view of the particular facts and circumstances pertaining thereto.

22. Substitution of Rates

The rates, rules and regulations as above established, approved by the Railroad Commission of Wisconsin on shall apply to all rural Customers attached to the Company's lines after

Any rural Customer attached prior to may now, or at any future date during the limitation period herein set forth, elect to be served under this schedule.

Rural customers attached prior to who do not elect to be served under this schedule, will be continued on their present system of rate charges until a period of five years from date of connection to the individual Customer at his location as of shall have elapsed. After such five-year period, the Company may at its option place any such Customer under the operation of these rates, rules and regulations; provided, however, that no such five-year period shall be deemed to expire for any individual Customer within two years from date of order (.....).

The five-year period of limitation shall apply to each rural Customer as at his existing location on and to no other location.

23. Refunds to Customers

Whenever a rural customer elects to be served under the conditions above set forth in place of any former rural schedule, the following rules will apply:

- (a) The Company will refund to the Customer the Customer's investment in the extension, up to a maximum amount of \$400.00.
- (b) The refund to the Customer may be made in either of the following ways, or by any combination of them, by mutual agreement between the Company and the Customer:
 1. Credit on the Customer's monthly service charge under the new rural rate.
 2. Electrical equipment.
 3. Preferred stock in the Company.
- (c) If the refund from the Company to the Customer is not sufficient to cover the Customer's investment in

the rural extension, then the Customer will be eligible to receive further refunds which may become available through the connection of additional customers. But no refunds will be made on account of any new connections made after five years from the date when these rules are approved by the Railroad Commission. In no case shall the sum of all refunds paid to a Customer exceed his contribution toward the cost of the rural extension.

- (d) The rural charge or service charge for other Customers served from the same rural extension will not be affected by such a substitution of rates. The rural charge for the extension will remain the same as that in force on the date of the first such substitution.

RURAL SERVICE CONTRACT

Customer.....	Dist.....
Line	
County	
Town	
Trans. Size	Phase.....
No. Served	
Date of Connection	
Initial Advance.....\$.....	Date.....
Bal. after Refund.....\$.....	

FIG. 4—FACE OF CONTRACT, WISCONSIN POWER & LIGHT CO., MADISON, WIS.

APPENDIX E

GENERAL ORDER NO. 27 PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA ESTABLISHING RULES AND REGULATIONS FOR RURAL SERVICE

1. Intent

This order is made to facilitate the securing of electric service by farmers and others in rural territory.

2. Definitions

Where used in this order singular words shall be construed as including the plural, and the following terms shall have the following meanings respectively designated for each:

"Consuming establishment" at any time means any then existing building, structure, farm, works, or other establishment of a kind such as is customarily served anywhere in the Commonwealth with current for light, heat and power or any of them, including dwellings, barns, hotels, dairies, stores, factories, mines, quarries and other like and unlike buildings, structures, works and establishments.

"Rural area" means any part of the land area of the Commonwealth located wholly outside of the corporate limits of any city, town or borough.

"Rural consumer" means the owner, occupier or user of a consuming establishment in a rural area.

"Contracting consumer" means a rural consumer who shall have contracted with or offered to contract with any electric company to take for one full year and pay for current to be delivered to a consuming establishment owned or operated by him in a rural area.

"Rural line" means a line of poles and of wires mounted thereon proposed or constructed for the main purpose of distributing current to one or more rural consumers.

"Point of origin" means the point where an actual rural line connects with or begins to extend from, or where a proposed rural line is to connect with or is to begin to extend from any transmission or distribution line of any electric company, and where such rural line receives or is to receive current from such electric company.

"Measured mile" means any one of the consecutive parts of a rural line, beginning at the point of origin, each part one mile in length, except the last which shall be one mile or less in length.

"Rural distributing association" means an association or other organized body of persons for the purchase of current and the supply of the same without profit exclusively to its members or stockholders, being rural consumers.

"Electric company" means any corporation or person, which is a public service company within the definition of that term in the Public Service Company Law and which is under an obligation to supply current to the public.

"Current" means electric energy generated, transmitted and distributed, or any of them, for the supply of light, heat and power, or any of them.

A "service" means wires and other appliances of adequate capacity from the pole nearest the consumer's building to a point on the building approved by the utility.

"Person" includes natural persons, corporations, partnerships and associations.

"Commission" means the Public Service Commission of the Commonwealth of Pennsylvania.

3. Rural Consumers Classified

For the purposes of this order rural consumers are divided into two classes, as follows:

Class I. Those served with current by a rural distributing association or those who demand service of current from an electric company through a rural distributing association;

Class II. Those served with, or demanding to be served with, current directly by an electric company.

4. Standards for Construction, Operation and Maintenance of Rural Lines

All rural lines shall be constructed, maintained and operated in such manner as to be reasonably adequate and practically sufficient for the accommodation and safety of its patrons, employees and the public. The Commission upon its own initiative, or upon complaint, may cause any rural line to be inspected and may determine whether or not such rural line is or is not so constructed, maintained and operated. The delivery of current to, and the serving of current over any rural line found by the Commission to be not so constructed, maintained and operated is hereby prohibited. Any electric company may, as a condition precedent to delivering current to any rural line of any rural distributing association, contract with such rural distributing association as to liability or indemnity for injuries to persons and property by current on or from the rural lines of such rural distributing association.

5. Tapping of Lines

Every alternating current, single or multiple phase, transmission or distributing line of the parallel type of any electric company having a nominal voltage of 15,000 volts or less between the wires of one phase (neutral wire excluded) shall be considered as offering a point of origin at every point within territory chartered to such company, except as in this section hereafter provided. In the absence of other means of such electric company's delivering current to such rural consumers, such lines of such electric company shall, on the demand of any rural distributing association, or rural consumer, be there tapped by such electric company for the purpose of connection with any rural line which such electric company is by this order obligated to construct, or with any rural line of such rural distributing association. Every such transmission and distribution line of any electric company having a nominal voltage between 15,000 and 33,000 volts between the wires of one phase (neutral wire excluded) shall in like manner and upon like demand be tapped at any point for the purpose of connection with any such rural line when such rural line is considered by such electric company or found by the Commission to afford a reasonable prospect of a peak load reaching 100 kv-a. within one year after such tapping.

Provided: That upon proper cause duly shown such electric company may be relieved by the Commission from the duty of tapping at any particular point.

6. Annual Reports of Rural Extension to Be Made

Every electric company and rural distributing association shall file with the Commission on or before January 31 of each year a report covering the twelve-month period ending December 31, showing—

(1) The number of miles of rural lines in operation by it at the beginning of such twelve-month period.

(2) The number of miles of rural lines constructed by it during such twelve-month period.

(3) The number of rural consumers taking service from its rural lines at the beginning and end of such twelve-month period.

(4) The number of kilowatt hours of energy consumed from such line during the twelve-month period.

(5) The gross revenue derived from such lines during the twelve-month period.

7. Demands for Service Apart from This Order—Amendment of This Order

Nothing in this order shall be construed to prevent the Commission from considering upon its own merits and acting upon any demand otherwise lawful for service nor to preclude the Commission from altering, modifying, or amending this order from time to time as the Commission may deem necessary or advisable nor to preclude the Commission from relieving any electric company from the obligation herein imposed should the special circumstances of the case warrant such relief.

8. Rate Schedules for Service to Rural Distributing Associations

Every electric company having rural territory within its charter territory shall on or before April 1, 1926, establish and thereafter maintain in the manner provided by law a schedule of rates for the sale of current to rural distributing associations. Electric companies shall sell current to rural distributing associations only at the rates fixed by such schedules or at other rates duly fixed by the Commission in accordance with law.

9. Contracts for Construction, Operation and Maintenance of Lines of Rural Distributing Associations

Any electric company may contract with any rural distributing association for the construction, maintenance and operation, or any of them, of any or all rural lines of such rural distributing association. Copies of all such contracts shall be filed with the Commission by the electric company within two weeks after the execution thereof.

10. Duty of Electric Company to Construct Rural Lines

It shall be the duty of every electric company, subject to the limitations of its tapping duty fixed by Section 5 of this order, to extend its distribution system by building rural lines to serve rural consumers of Class II within its chartered territory. Each such rural line shall extend to the most distant contracting consumer who will, alone or in company with other intervening contracting consumers, contribute to the cost of construction of such rural line. Such contribution shall consist of such portion, if any, of the estimated cost of such rural line, (if constructed according to but not exceeding the minimum capacity and standards of rural line construction necessary to serve said contracting consumers), as the electric company is not required to pay by Section II of this order.

11. Same—Demand by and Contributions from Contracting Consumers

Upon the demand of any contracting consumer within the chartered territory of any electric company for the construction of a rural line to serve him, designating the point of origin, the electric company shall furnish to him an estimate of the cost of such construction. Upon payment to such electric company of the portion of such estimated cost, if any, as the electric company is not herein required to pay, such electric company shall construct such rural line.

The cost of each separate measured mile of such rural line from which three or more contracting consumers are to take current shall be borne by such electric company. The cost of each separate measured mile on such rural line from which less than three contracting consumers are to take current shall be borne by such electric company to the extent that such cost shall not be in excess of three hundred dollars (\$300) per contracting consumer. The electric company is not obligated to construct such line until it has received from the contracting consumers a sum equal to such excess.

12. Construction Cost

The construction cost of any rural line built under this order shall include the following:

All costs of labor and materials directly chargeable to and necessary to construct a line from the designated point of origin to the consuming establishment. Such costs shall include transformers, meters and services not exceeding one hundred (100) feet in length from the pole nearest to the consumer's terminal. The line shall be of the minimum capacity and standards necessary to render reasonably adequate and safe service to the contracting consumer.

To the above may be added an item not exceeding fifteen (15) per cent of these costs to cover engineering, promotion, office supervision, clerical labor, and contingencies.

Should such electric company desire to serve the contracting consumer by a line having a point of origin different from that designated, or should it desire to construct a line having a cost greater than the cost of a line of minimum capacity and standards necessary to render reasonably adequate and safe service to the contracting consumer, the construction cost to the consumer shall not be increased thereby; but any such additional cost shall be borne by the company. In case of dispute, the estimated construction cost may be determined by the Commission.

13. Title to Rural Lines Financed in Part by Contributions

No electric company shall be obligated by this order to deliver current to any rural line constructed under Sections 10 and 11 of this Order and financed in part by any advance from any rural consumer, until every consumer making any such advance shall have agreed in writing that the ownership of such rural line shall vest in such electric company. Such electric company shall be obligated to maintain and replace at its own expense all rural lines constructed under Sections 10 and 11 of this Order as public safety and convenience may require.

14. Same—Refunds and Assessments if Estimate Be Too Large or Too Small

In the event that the actual construction cost of any measured mile of any rural line constructed by any electric company under this Order shall have been less than the estimate of such cost made under Sections 11 and 12 of this Order, then such company shall make refunds to all persons who shall have made advances. Such refunds to be the difference between the advances actually made and the advances that would have been sufficient had the estimated cost been the same as the actual construction cost. In the event that such actual construction cost shall have been more than such estimate such company is not required to serve until the persons who shall have made advances shall pay to such electric company the sums they would have been required to pay had the estimated cost been the same as the actual construction cost.

15. Connection Charge for Additional Consumer

An additional contracting consumer shall be connected to any rural line constructed under this order upon the payment by such additional contracting consumer of a connection charge. This connection charge shall be such sum as such additional contracting consumer would have been required to pay had he been a contracting consumer at the time of the construction of the rural line from which he desires service. If the rural line was constructed partly at the expense of contracting consumers the electric company shall refund to the contributing consumers a sum equal to the difference between the payments made by them and the payments which would have been required had the additional contracting consumer been one of the original contracting consumers. Nothing in this section shall apply

to connections with rural lines made more than five years after the line is constructed.

16. Blanks for Contracting with Rural Consumers

Every electric company having rural territory within its chartered territory shall prepare and shall reasonably supply to all rural consumers in its chartered territory who shall desire the same, blanks suitable for signature by prospective rural consumers who by such signature and delivery thereof to such electric company and performance of all conditions agreed to by such signature, shall become contracting consumers, said blanks to be in substantially the following form:

(Name of Electric Company)

Gentlemen:

You are hereby requested to supply electric service for an equipment of approximately kw., consisting of the following:
.....
.....
installed in or upon premises located at
in the Township of, County,
Pa., occupied as a by
hereinafter known as the Consumer.

The Consumer hereby agrees to use, subject to the terms and conditions contained in the rules of the Company, lawfully established, electric service supplied by you for said equipment, for the term of one year from the date the Consumer receives written notice from the Company that service will be commenced, which term shall be continued thereafter from year to year unless written notice shall be given 30 days prior to the end of the yearly term. The Consumer agrees to pay for such service at the rates and in conformity with the rules lawfully established by the Company or by The Public Service Commission.

The Consumer agrees that the electric current so furnished shall not be used except for the equipment herein scheduled without previous notice and consent of the Company.

Upon acceptance by the Company and the installation of equipment necessary to render the service herein requested, this application shall constitute a binding contract.

.....
(Name of Consumer)

Accepted By:

.....
(Consumer's address)

Date of acceptance:
.....

17. Limitation of Application of This Order

None of the provisions of this Order shall apply to any rural line containing a greater total number of measured miles than the total number of contracting consumers who shall receive service directly from such rural line. Nor shall any of its provisions apply to lines of an electric company located in territory in which the Commission in issuing its certificate of public convenience to said electric company has provided that no service should be rendered to consumers.

By order of the Commission, at Harrisburg, Pa.,
this 12th day of January, 1926.

Convention Report

RURAL ELECTRIC SERVICE COMMITTEE

1927-1928

To be presented at the Fifty-first
Convention, Atlantic City, N. J.
June 4 to 8, 1928

NATIONAL ELECTRIC LIGHT ASSOCIATION

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FOREWORD

This report has been prepared and edited by the
RURAL ELECTRIC SERVICE COMMITTEE
for presentation at the Fifty-first Convention of the
Association at Atlantic City, N. J., June 4 to 8, 1928

COMMITTEE PERSONNEL

Chairman, CHARLES F STUART, Northern States Power Co, Minneapolis, Minn
D E BLANDY, New York Power & Light Corp, Albany, N Y
G C NEFF, Wisconsin Power & Light Co, Madison, Wis
F A BELDEN, The Edison Electric Illuminating Co, Boston, Mass
RICHARD BOONSTRA, Public Service Co of Northern Illinois, Chicago, Ill
MARKHAM CHEEVER, Electric Bond & Share Co, New York City, N Y
F S DEWEY, Kansas City Power & Light Co, Kansas City, Mo
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O H HUTCHINGS, The Dayton Power & Light Co, Dayton, Ohio
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J F OWENS, Oklahoma Gas & Electric Co, Oklahoma City, Okla
BERT H PECK, Illinois Power & Light Co, St Louis, Mo
E N STRAIT, Byllesby Engineering & Management Corp, Chicago, Ill
NORMAN R SUTHERLAND, Pacific Gas & Electric Co, San Francisco, Cal
H L WILLS, Georgia Railway & Power Co, Atlanta, Ga
JOHN S WISE, JR, Pennsylvania Power & Light Co, Allentown, Pa
ARTHUR HUNTINGTON, Iowa Railway & Light Co, Cedar Rapids, Ia
L A McARTHUR, Pacific Power & Light Co, Portland, Ore
PHILLIPS B SHAW, National Electric Power Co, New York City, N Y
C V SORENSON, Attica Electric Co, Attica, Ind
H M WEATHERS, Alabama Power Co, Birmingham, Ala
DR E A WHITE, Committee on the Relation of Electricity to Agriculture, Chicago, Ill
E F KELLY, Central Illinois Public Service Co, Mattoon, Ill

Geographic Division Representatives

Canadian—H I ANSCOMBE, Ottawa Electric Co, Ottawa, Ont, Canada
Eastern—C E OAKES, Pennsylvania Power & Light Co, Allentown, Pa
East Central—J B JOHNSON, Ohio Public Service Co, Elyria, Ohio
Great Lakes—EUGENE HOLCOMB, Consumers Power Co, Jackson, Mich
Middle West—J E HILLEMAYER, Union Electric Light & Power Co, St Louis, Mo
New England—R H ALTON, Worcester Suburban Electric Co, Uxbridge, Mass
North Central—R P ALLEN, Eastern Minnesota Power Co, Pine City, Minn
Northwest—J C SCOTT, Puget Sound Power & Light Co, Seattle, Wash
Pacific Coast—
Rocky Mountain—J A CLAY, Western Colorado Power Co, Durango, Colo
Southeastern—E W ASHMEAD, Alabama Power Co, Birmingham, Ala
Southwestern—O A JENNINGS, Oklahoma Gas & Electric Co, Oklahoma City, Okla

CONTENTS

	PAGE
General	1
Rural Service Departments	2
Commission Orders and Rulings During 1927	3
Rural Line Construction Standards	4
The National Rural Electric Project	4
Cooperation for Promotion of Harmony	5
Committee on the Relation of Electricity to Agriculture	5
Short Courses in Electricity on the Farm	6
Government to Count Electrified Farms	6
Publicity	7
Directory of Rural Electric Service Departments and Specialists	7

RURAL ELECTRIC SERVICE COMMITTEE

GENERAL INTRODUCTION

It is probable that no year in history has witnessed such significant developments in the application of electricity to agriculture as the year just closed. Farmers, farm organizations, agricultural colleges, the electric industry, manufacturers of electrical equipment, manufacturers of farm machinery, governmental departments, all have been stepping harmoniously forward, overcoming obstacles, developing new facts, interchanging and spreading information, enlisting new recruits, building farm lines and putting electric power to work at more and more tasks on an ever-increasing number of farms.

It is a gigantic task, this extension of electric service to the American farm. Only a few years ago a successful completion seemed an impossibility. It presented difficulties which seemed insurmountable. It called for a financial investment which sounded like the national war debt, and promised little in the nature of returns.

Your Committee, however, feels that it can conscientiously report that extension of service to the farm can and is being accomplished, and that further, and more important still, the services which the electric light and power companies are rendering to the farms now connected are bigger, broader and more numerous in character than anyone had any conception of when this work first was undertaken.

The National Committee on the Relation of Electricity to Agriculture has just published what it modestly calls a Bulletin. It is in fact a book—a most amazing book. It contains 136 pages, 210 illustrations and 83 statistical tables.

It is not a novel, not a story book. It is in reality a composite picture showing how electric light and power companies have carried electricity to the farm, how it has been put to work on the farm, and the results achieved. The data contained are a summary of the results of investigations conducted in twenty-four states during the past four years.

It contains under one cover all known information on the application of electricity to agriculture. It is not only a guide toward further development, but a practical demonstration of the progress already achieved.

During the year more and more electric light and power companies have organized themselves to undertake intelligently the extension of their service into agricultural territory. The year marked an increase of 60 per cent in the number of companies having either rural electric service departments or men especially trained in this particular field, and there is prospect of an even more material development in this line in the year to come.

As was reported by your Committee a year ago, the application of electricity to agriculture has passed the experimental stage. The test line investigations

in twenty-four states have been pretty well completed so far as facts necessary to our industry are concerned, though there are some additional data necessary to agricultural colleges and companies manufacturing electric and farm equipment. There remain, however, some experiments of a major character and some experiments covering types of farming in states where no such investigations have been in progress. This field is to be covered by a national experimental line in the state of Maryland. It is to operate under the auspices of the National Committee on the Relation of Electricity to Agriculture, cooperating with a state of Maryland committee. The project is dealt with more in detail further along in this report. It will develop facts of particular interest to Maryland farmers and also will enable investigators to carry on some major experiments, which have not been possible on the state lines, but which should be of general interest to agriculture throughout the nation.

No attempt was made to count the number of additional farms connected in 1927, as this work has now been included in the periodical electrical census taken by the Bureau of the Census, Department of Commerce. It is significant, however, that in four states, where electric utility organizations made such a count, it is found that electric light and power company service was extended to 21,217 additional farms.

Information received pertaining to organization, development, and operation of rural electric service departments by several companies indicates that farm business properly undertaken can be made mutually satisfactory to farmer and power company. These departments prove by their own experience that in this supposedly most discouraging of fields, an acceptable load, in many instances, can and has been developed to the mutual satisfaction of both parties to the transaction. This has been accomplished by intelligent load building, by which is meant the application of electricity to agricultural tasks in such a way as to promote energy consumption and at the same time cut labor costs and increase farm production.

A subcommittee of the Overhead Systems Committee of the Engineering National Section has this year made a most substantial contribution in a report fixing standards for rural line construction. This is a valuable document and is commented on further in this report.

One of the biggest problems still remaining is that of acquainting the farmers themselves with the possibilities of electricity on the farm. Times have been far from prosperous for many of them. They have been too busy scratching a living out of the soil to keep pace with the rapid progress being made in the application of electricity to agriculture. To millions of them the vision of electricity on the farm is confined largely to a more acceptable type of illumination. They do not know that nearly 200 different services on the farm can be performed

by intelligent employment of electricity. It is only within the last few years that definite information has been available, and as a consequence it often is found that in a given rural community only one-third of the farmers are alive to the progress which has been made, and the relief from drudgery made possible by modern day application of electricity. It is also true that some utility organizations have not kept pace.

This problem of acquainting farmers with the modern day idea of electricity on the farm is not discouraging at all. It merely means that such communities are not yet ready for electric service, but that as neighboring communities, more familiar with the situation, put electricity to liberal use on the farm, these more backward communities soon will profit by the example set. Other means may be adopted for spreading information, but whatever the means, it is highly probable that it will not be long before all rural America is not only alive to what electricity can accomplish on the farm, but also willing and anxious that it should be done.

RURAL ELECTRIC SERVICE DEPARTMENTS

Only a few years ago the establishment by an electric light and power company of a rural electric service department was regarded as a very formidable and hazardous proposition—something of an adventure to be undertaken, if at all, only after grave consideration and mature deliberation. That day, however, is past. Pioneers in the application of electricity to agriculture have blazed a conspicuous trail, marked by definite and specific information, and it is the prediction of this Committee that within a comparatively few years every electric company occupying considerable rural territory will have a rural electric service department.

Creation of such a department is no longer an adventure, no longer difficult nor hazardous. In fact, it is now regarded as the one logical and sensible way to meet the demand of agriculture for electricity on the farm. If anyone has a better way it has not yet been revealed.

The plan of procedure, once regarded as calling for much preliminary consideration, now is simple. The executive head of the company selects an individual, perhaps one already on the payroll, to take charge of this work. This selection, of course, requires some judgment, as the person picked should not only know the electric business, but also something of farming, and he should be what is termed sympathetic with agriculture. If he is not thoroughly up-to-date on the progress which has been made these last few years in putting electricity to work on the farm, he can speedily remedy that for a wealth of specific information regarding electric farming in all sections of the country now is available to him.

Next there should be devised a rate. This should be no more difficult than devising a rate for any other class of business. The tendency among companies which have progressed in this field is for the company to finance all or a considerable part of the cost of building the line. In so far as the rate it-

self is concerned, the thought of principal importance is that it should be a form of rate which will encourage liberal consumption.

The next move is for a survey of the agricultural areas included in the company territory, taking into consideration the different types of farming, density of population, existence of present lines available for farm service, natural geographic boundaries, etc.

There is nothing very difficult, hazardous, nor intricate about any phase of this procedure. It is merely approaching farm service in a common-sense way, the same as electric companies have approached other classes of business. It is the only means by which requests for farm service can be met intelligently, and it is the only means by which the rural load can be built intelligently.

It is possible, however, that managers of some companies are a little afraid of this phrase "rural electric service department." It may spell to them the creation of an entirely new and independent department at considerable additional expense. The word "department" is used advisedly. It does not necessarily mean a lot of new employees. It may mean only the designation of one company employee to give part of his time to rural electrification. From that point the "department" would grow only as development of rural business might demand.

It probably would be easier to sell company managers on the importance of establishment of the rural electric service department if the word "department" were not used. Experience has demonstrated, however, that the very fact that the company has such a department is a distinct company asset. It makes no difference how modest that department may be in size. It makes no difference if it is merely a part of the sales or some other department—there remains the outstanding fact that the company has such a department. This fact inspires confidence in the mind of the farmer. Even if the department consists of only one man, and if that one man gives only part time, it is gratifying to the prospective farm customer calling at the office to be referred to the rural electric service department, and there to come in contact with a man sympathetic with agriculture and fully conversant with the modern idea of electrifying the farm factory.

Two things must be obvious—first, that rural service is a class of business by itself and must be handled by individuals thoroughly trained in and acquainted with the subject; second, that the individual, or individuals, engaged in this work should be regarded as a department, for it reflects in no way on the sincerity of their work and certainly gives the farmer justifiable cause for confidence in the company with which he is dealing.

In other words, if a company has men trained in the application of electricity to agriculture, there is no use making a secret of it. They are justified in calling this branch of company service a department and letting the agricultural world know about it. In fact, rural electric service departments in many companies have their own stationery with appropriate letterheads so that in correspondence with the

farmer, he is made aware that he is dealing with a company which has a department which knows something about putting electricity to work on his farm.

Unquestionably many companies have been deterred from establishing rural electric service departments by this bugaboo of hazard, adventure and additional expense. Your Committee, however, is gratified that it is nevertheless able to report a material increase in the number of companies having such departments and companies having men especially trained in the application of electricity to agriculture, though they may not be designated as rural departments.

In June, 1927, your Committee reported 57 companies having separate rural electric service departments and 43 companies having men especially trained in this line, though not designated as departments, or a total of 100. This year, because of the difficulty in determining just what constitutes a rural electric service department, your Committee has grouped them all under one head, and the report this June shows a total of 160 companies, or an increase of 60 per cent, and also shows that these 160 companies have 403 men especially trained and active in rural electric work.

COMMISSION ORDERS AND RULINGS DURING 1927

This report covers items of interest regarding public utility contact with state regulatory commissions. It should not be regarded as entirely complete, but covers all facts which have been ascertained. The items are segregated by N. E. L. A. Geographic Divisions.

Eastern Division

Following the issuance of General Order No. 28 last year by the Pennsylvania Public Service Commission, as reported in last year's report, the Pennsylvania Joint Committee on Rural Electrification was formed, and was officially recognized by the Pennsylvania Commission. It is composed of about equal representation from the State Council of Agricultural Association and representatives of the Pennsylvania Electric Association. It maintains a full-time secretary at the state capitol, to whom the Public Service Commission refers inquiries and informal complaints. During its existence some 300 inquiries and informal complaints have been so handled, and our information is that no complaints have been referred back to the commission for formal settlement.

East Central

A joint meeting of electric utility representatives and members of the various farm organizations in Ohio was called for an informal conference with the Public Utilities Commission in Columbus on March 22, 1928.

As a result of this conference a committee of nine members of the various interested parties was appointed, consisting of three public utility members, and six from the various farm organizations in Ohio and other agencies interested in rural electrifi-

cation. This committee has agreed to collect and compile all available information on the status of rural electrification up to the present time and place this information before the Public Utilities Commission as soon as possible.

The Public Utilities Commission has indicated that no order relating to rural electrification will be promulgated until this information is presented, and when the same has been presented then will decide upon a course to follow.

Great Lakes

Reference was made in last year's report to the so-called Second Interlocutory Order of the Illinois Commerce Commission regarding Standards of Rural Construction.

On June 23, 1927, the Commission adopted General Order No. 115, superseding General Order No. 30, covering rules on overhead line construction. The comments made by the assistant chief engineer, J. H. Mathews, in a letter to Eugene Holcomb, Great Lakes Division Chairman, should be of interest and a part of his letter is reprinted here:

On June 23, 1927, the commission adopted General Order No. 115 to supersede General Order No. 30—in the matter of rules for overhead line construction. These rules set up a factor of safety of 1 for strictly farm lines, a factor of safety well below that being practised by most of the utilities prior to that date. The commission had previously entered an order, generally known as the "Second Interlocutory Order," in conjunction with the procedure bearing on proposed General Order No. 115, which interlocutory ordered entered April 27, 1926, set up standards of construction for rural service which the commission believed would encourage rural development. It had been apparent from complaints filed with the commission that the estimates set up by most companies were excessive, and in the opinion of the commission represented costs of construction materially higher than necessary to render sufficient and adequate service for rural purposes. In this opinion, the electric utilities, through the Illinois State Electric Association, seemed to have ultimately concurred.

For your information I am inclosing herewith a copy of the Second Interlocutory Order referred to above, the reading of which I believe will give you a fair idea of the commission's attitude toward this matter.

Following the entry of the Second Interlocutory Order, and in accordance with its requirements, the electric utilities, which were furnishing or proposed to furnish rural service, filed estimates. In general these indicated widely different opinions relative to construction costs, as the previous estimates seemed to have done, and some of them were entirely out of line with what this department felt to be reasonable. Since that date there seems to have been more or less diligent effort on the part of certain utilities to set up adequate standards, and the whole procedure has resulted generally in a material lowering of rural line costs over what were considered good practice two or three years ago. Subsequently a number of utilities have reduced to about \$900 or \$1,100 a mile estimates for lines which were previously estimated to applicants for service as costing \$1,500 to \$2,000 a mile. Those utilities which are sincerely endeavoring to develop rural business seem to be satisfied that they can build lines at that figure or below.

The Illinois Commission also states that it has accepted some rates for rural service of the service charge type, and also accepted the filing of rural rates in which the minimum bill for a transformer of 3 kv-a. or less is \$10.00 per month. This minimum includes the use of 135 kw-hr., after which the

charge is 3c. net per kw-hr. The utility finances to the extent of \$450 per customer.

Middle West Division

The Missouri Public Service Commission reports that no general or special orders have been issued. The Ozark Utilities Company has filed a rural rate in this state.

The Iowa Board of Railroad Commissioners has adopted a part of the National Safety Code which will govern minimum requirements of supply line construction and maintenance, and which will apply to rural service when transmission lines are used therefor.

We are advised that several Kansas companies have filed rural rates, among them being Municipal Power Transmission Company, Kansas Power & Light Company, United Power & Light Corporation and Kansas City Power & Light Company.

New England Division

This Division reports that there have been practically no rate investigations and orders.

Northwest Division

No important orders and changes have been made.

Southeast Division

The Georgia Public Service Commission has issued an order requiring all companies operating in that state to file rural rates.

Southwestern Division

The Oklahoma Gas & Electric Company has filed a service charge type of rate for rural service.

The Oklahoma and Louisiana Commissions have issued no general orders during the year.

Conclusion

Study of rural rate schedules and commission orders indicates a conscious effort to evaluate rural service and to put it on a sound basis. There seems to be a predominance of service charge types in the schedules placed on file.

In general, it also appears that the central section of the country is more committed to the service charge type than is either the Atlantic or Pacific Coast sections.

RURAL LINE CONSTRUCTION STANDARDS

The Overhead Systems Committee of the Engineering National Section is preparing a full and adequate report on rural line construction. This report has involved an infinite amount of study and research by the Subcommittee on Rural Line Construction Standards, of which Eugene Vinet is Chairman. It is impossible, at this writing, to say definitely when the report will be printed and ready for distribution, but announcement of publication will be made in the *N. E. L. A. Bulletin*.

There has been much diversity of opinion as to the best type of line construction for farm service. Many companies have been carrying on independent investigations and experiments over a period of

years, and many companies have hesitated about building any rural lines at all because of lack of definite and adequate information as to what type of construction should be adopted. They have preferred to wait until something definite and authoritative should become available.

It is the belief of this Committee that the forthcoming report of the Rural Line Construction Standards Subcommittee of the Overhead Systems Committee will fulfill this long-felt want.

The report is based on information and experience from all over the country. It is based on theory plus practical application, and will contain a wealth of detailed and reliable information. Companies using it as a guide will avoid many of the mistakes which have been made in the past.

Most important of all, it furnishes definite information for the guidance of any company desirous of building rural lines and eliminates for all time postponement of extension into agricultural territory because of doubt as to the proper type of construction to adopt.

This Committee wishes to express its appreciation to the Engineering National Section for this splendid contribution to the development of rural electric service.

THE NATIONAL RURAL ELECTRIC PROJECT

Practical cooperation extended by the electric utilities of Maryland enables your Committee to announce at this time a project of significant importance to both the electric industry and to agriculture. It consists of a national experimental rural electric line within a few miles of the city of Washington. This national project is to be different in many ways from the experimental investigations in rural electrification now in progress in some twenty-four states. The difference lies mainly in the size and scope of the undertaking.

The respective state experiments have yielded a wealth of valuable information regarding the more simple and obvious applications of electricity to agriculture, but none of these state enterprises has been built or financed on a scale which would permit of some of the larger and more intricate experiments which this Committee has in mind.

As a consequence, it was felt that investigations of this broader nature should be carried out on a line national rather than strictly state in character, and it was deemed fitting that such an investigation should be located in the state of Maryland immediately adjacent to the national capitol, which always has and always will be a mecca for leaders in agriculture, engineering and science.

This could not have been done, however, without the cooperation of the utilities operating in the state of Maryland, and this Committee wishes to extend its thanks to them, and in particular to Herbert A. Wagner, president of the Consolidated Gas, Electric Light & Power Company of Baltimore, Md.

This project was discussed with Mr. Wagner late last fall. He was keenly appreciative of what it would mean for agriculture in the state of Maryland as well as the valuable information that might

be developed for the advancement of agriculture throughout the nation, with the result that this speedily was followed up by active cooperation from all the electric light and power companies in the state of Maryland.

On Feb. 16, 1928, there was held in the offices of the Consolidated Gas, Electric Light & Power Company in Baltimore the first general meeting looking toward the launching of this project. The enterprise will operate under the direction of the National Committee on the Relation of Electricity to Agriculture in cooperation with a Maryland state committee. This joint organization will embrace representatives from the leading farm organizations of Maryland, the United States Department of Agriculture, the University of Maryland and the Agricultural College, the Maryland electric utilities, the National Committee on the Relation of Electricity to Agriculture and the Rural Electric Service Committee of the National Electric Light Association. Following the meeting, immediate steps were taken toward choosing a location for the demonstration.

The project will include a group of six to ten farms in one community, one or more individual farms in the immediate general vicinity for the purpose of particular experiments, possibly the absolute acquisition of some one farm where absolute freedom of experiment may be obtained, and likely a general headquarters building for office and concentration of all information on rural electrification. This building may be made the permanent office of the National Committee on the Relation of Electricity to Agriculture.

In a general way the order of progress will be as follows:

1. The farms will be properly wired and lighted. The homes will be equipped with the usual electrically operated household appliances and the farmsteads with the type of electrically operated equipment which has proved practical on experimental farms in other states.

2. Special attention will be given to kind of equipment particularly adapted to the types of agriculture peculiar to Maryland.

3. Major experiments which would prove of interest not only to agriculture in Maryland but to agriculture in all parts of the country will be undertaken. Among the first of these will be tests as to the practicability of electric soil treatment through the medium of an electrified plow, and to certain types of electric hay drying, which, if proved practical, would be of immense advantage in every agricultural district where hay is grown in quantities. Several other major experiments are in mind.

4. It is planned to make the electrified Maryland community a show spot, a district of infinite educational value to everyone interested in agriculture. A large electric sign is to be erected to call attention to the nature of the project.

COOPERATION FOR PROMOTION OF HARMONY

The rural electric field is so new that there is much honest conflict and equally honest difference of

opinion as to fair and equitable methods in the building of farm lines and as to the proper charges which should be made for this type of service.

If improperly approached this situation might lead to a good deal of ill feeling and permanent misunderstanding. Sound judgment on the part of individuals in a number of states is proving by practical example how such conflict of opinion and belief can be adjusted so that good-will and mutual understanding will prevail.

Instead of power companies and farmers going before their State Commission with the determination to engage in a free-for-all battle, the Commission to decide the winner, these two industries, farmers and power companies, get together first with a mutual desire to come to a satisfactory agreement.

It is generally found at these meetings of farmers and power company representatives that each one has much to learn of the other's business and problems, but that when all the facts are on the table, neither one wants anything that is not fair, and that a satisfactory agreement can be arrived at. When this has been accomplished, appearance before the Commission becomes merely a formality. Such a procedure has done much to promote general understanding between the farmers and power companies in Pennsylvania, and resulted finally in the issuance of a general order by the State Commission which met with the approval of a majority of both the industries concerned. A similar method was adopted successfully in parts of Wisconsin. In Ohio and in the New England states power companies and farmers are even now in conference. They are carrying on investigations which, it is hoped, will lead ultimately to harmony.

THE COMMITTEE ON THE RELATION OF ELECTRICITY TO AGRICULTURE

Under the guidance of Dr. E. A. White, the National Committee on the Relation of Electricity to Agriculture, 1120 Garland Building, Chicago, Ill., during the year made substantial contributions toward extending electric service to additional farms and toward its intelligent application on the farms served. A strong feature of the organization of this committee is the fact that it represents every agency which has an interest in electricity on the farm.

Its outstanding achievement during the last year was the publication of C. R. E. A. Bulletin, Volume IV. No. 1, dated Jan. 30, 1928. It is doubtful if there are many known facts relative to electrification of the farm that are not included between the covers of this bulletin, which really deserves some more pretentious name because it is in reality a book of 136 pages, 210 illustrations and 83 tables.

The information contained is collected in the main from the experimental projects in progress in twenty-four states. It is proving a material and practical aid to everyone having anything to do with electricity on the farm. It is of equal value to the power company representative, agricultural college faculty, farmer, manufacturer of farm machinery, manufacturer of farm implements, manufacturer of barn

equipment, and to governmental agencies interested in the subject.

Many electric light and power companies are purchasing this bulletin in quantities for distribution to present and prospective farm customers. It is proving an inexpensive and effective means to enable farmers to obtain full conception of modern day farm electric service.

The committee is following this particular publication with a bulletin on farm wiring which also is bound to prove of great value as proper wiring represents the foundation necessary to successful farm service.

Your Committee recommends to member companies having agricultural territory purchase on a liberal scale of C. R. E. A. Bulletin, Volume IV, No. 1, and strongly advocates continuance of the activities of the National Committee on the Relation of Electricity to Agriculture.

SHORT COURSES IN ELECTRICITY ON THE FARM

During the year Short Courses for rural electric service men of utility companies were held at Purdue and Wisconsin Universities and the Oregon Agricultural College.

These Short Courses were held under the supervision of the experiment project leaders with the cooperation of the State Rural Service Committees, and were designed to acquaint utility men with the practical results of experimental activities. As a result, several hundred utility men have been given first-hand knowledge of applications of electricity to agriculture which may be recommended to their farm customers.

Plans are under way to increase these activities during the coming year, and they will no doubt prove very beneficial.

GOVERNMENT TO COUNT ELECTRIFIED FARMS

A survey by the Rural Electric Service Committee showed that at the end of 1923 there were 165,000 farms obtaining service from electric light and power companies in the United States. In 1926 a similar survey determined that approximately 227,500 farms in 27 states were supplied with electric service. In 1923 these 27 states had only 122,000 electrified farms, so that 105,500 farms were added in the three-year period ending Dec. 31, 1926. This was an increase of 86.6 per cent in the 27 states reporting.

Your Committee made no attempt to obtain a record of additional farms connected in 1927. This was due to the fact that this year the Bureau of the Census, Department of Commerce, included such a count in its general census of information pertaining to the electric industry. This government census is now being taken, and your Committee recommends very strongly that every electric light and power company make it its particular business to supply the Bureau of the Census with full information as to number of farms connected.

If the companies do not do this the census takers

will be seriously handicapped in their work. The electrical industry must itself accept the blame if the final count shows a total materially less than the actual number of farms connected.

It should be remembered that the census of farms connected is not a separate and independent count. The Census Bureau has a questionnaire of many pages designed to produce much useful information regarding practically every phase of the electrical industry, and the count of the number of farms is but one of many items included in this questionnaire. It is to be found on Sheet No. 4, Table No. 10, of the census forms. That part pertaining to farm service reads as follows:

Classification of Sales	Number of Customers	Kilowatt- Hours	Revenue
Sales to ultimate consumers:			
Farm service (all uses).....			\$.....

It will be seen from this that the government is asking for the number of farms connected, kilowatt-hours sold and revenue received. This should not be very difficult for any company to supply. The principal trouble will be in separating actual farm customers from rural customers. Quite a number of companies group all customers in rural districts, including farms, filling stations, garages, churches, schools, creameries, etc., under the general heading of rural customers. Compliance with the request of the Bureau of the Census will necessitate the companies segregating actual farm customers from other rural consumers. In doing so, your Committee recommends that the companies accept the Bureau of the Census definition of a farm. The definition is as follows:

A farm is any place of three or more acres to produce agricultural products; or any place three acres or less where the yearly revenue from agricultural products is more than \$250; or any place three acres or less where the owner or tenant devotes his entire time to agriculture.

When the Bureau of the Census announces that a city has a population of so many people, the city may protest and recount and protest some more, but it usually is found that the census figures stand and are accepted everywhere as accurate. This same will prove true of the Bureau of the Census count of farms connected if the companies fail to extend adequate cooperation.

While your Committee has not attempted a count of additional farms connected during 1927, there is much definite evidence to indicate that the extension of electric light and power company distribution lines into agricultural territory progressed to a gratifying extent during that year.

In several states count was made as to the number of additional farm customers taken on during the year. In the state of Washington a check was made by all the electric light and power companies resulting in a report of 700 miles of farm lines constructed and the addition of 5200 more actual farm customers. This does not include rural customers other than farm customers.

Information from New York State shows that the actual farms served by electric light and power companies jumped from 35,600 to 43,200 during 1927, an increase of 7600 actual farm customers. This

figure of 43,200 represents 28.8 per cent of the grand total of 188,752 farms in the state. This, however, does not tell the whole story, for a survey shows that electric light and power company service is practically at the door of more than half the farms in New York. Definite figures show that 102,300 farms are within one mile of an electric distribution line which is indicative that before very long New York State will be able to show that 50 per cent or more of its total number of farms are served by power companies.

Pennsylvania is another state that checked up on progress in number of farms connected during 1927. The figures show that during that year 4317 additional farms were connected to the electric light and power company lines, making a total for the state of 16,296, or an increase of about 35 per cent during the one year. Here again the figures refer to actual farm customers. The total number of additional rural customers connected during the year was 17,663 but everything but actual farms have been eliminated from this figure.

Wisconsin also counted the additional number of farms connected in 1927 and reports an increase of 4100 actual farms.

In the four states just named, 1927 saw a total of 21,217 additional farms connected.

PUBLICITY

Your Committee has made no attempt to measure the amount of publicity which has been given this last year to electricity on the farm. Farm papers have devoted much space to this subject of such obvious interest to their readers, and on the whole have taken a very sound and intelligent view of the many factors involved. It is a mistake, however, to surmise that farm electrification is interesting only to readers of farm publications. Daily newspapers, weekly papers, magazines of national circulation, all have evidenced an ever-increasing interest in this subject. It is probably safe to say that no phase of the electric industry has received more publicity than that of the application of electricity to the farm.

Naturally some of this has been based on lack of knowledge, and a little of it has been hostile, but for the most part in all kinds of publications it has been both helpful and educational, and this committee wishes to extend its thanks to the publications for the aid they have given.

APPENDIX A

DIRECTORY OF RURAL ELECTRIC SERVICE DEPARTMENTS AND SPECIALISTS

East Central Division

Cleveland Electric Illuminating Co., Cleveland, Ohio.

R. C. Heinton, Painesville, Ohio.

M. Greenler, Painesville, Ohio.

Cleveland Southwestern Railway & Light Co., Cleveland, Ohio.

S. Natherson, 18200 Lorain Ave., Cleveland, Ohio.

(Three men on road giving entire time.)

1—Crestline, Ohio.

1—Lodi, Ohio.

1—Cleveland, Ohio.

Dayton Power & Light Co., Dayton, Ohio.

J. L. Mast, 205 E. First St., Dayton, Ohio.

Gene Bliss, Washington Court House.

H. R. Whiteman, Dayton, Ohio.

J. A. James, West Alexandria, Ohio.

L. Hufford, Piqua, Ohio.

R. E. Hadley, Wilmington, Ohio.

Kentucky Electric Development Co., Louisville, Ky.

D. W. Fowler, Louisville, Ky.

Louisville Gas & Electric Co., Louisville, Ky.

Willard Waggoner, Louisville, Ky.

Henry W. Schnepf.

Frank J. Wedekemper.

The Ohio-Edison Co., Springfield, Ohio.

P. G. Uhlman.

C. C. Printz.

H. J. Sheely.

Ohio Electric Co., Sidney, Ohio.

J. Clemens.

The Ohio Public Service Co., Warren, Ohio.

R. F. Pfile.

The Ohio Public Service Co., Mansfield, Ohio.

Earl Paxton.

Union Gas & Electric Co., Cincinnati, Ohio.

O. D. Walker.

Scioto Valley Railway & Power Co., Columbus, Ohio.

E. C. Schwaab, Canal Winchester, Ohio.

F. P. Sprague, Circleville, Ohio.

R. O. Miller, Frankfort, Ohio.

Union Power Co., Mullens, W. Va.

W. A. Meerman.

Wheeling Electric Co., Wheeling, W. Va.

B. C. Stolze.

Greenville Electric Light & Power Co., Greenville, Ohio.

K. C. Long.

Kentucky Power Co., Augusta, Ky.

L. W. Martin.

(One other man assigned to work.)

Lexington Utilities Co., Lexington, Ky.

I. W. Haley.

W. H. Clark.

Penn-Ohio Power & Light Co., Youngstown, Ohio.

T. E. Miller.

Potomac Light & Power Co., Martinsburg, W. Va.

W. M. Krise.

Appalachian Electric Power Co., Charleston, W. Va.

R. G. Skinner.

A. T. Wilks, Huntington, W. Va.

J. P. Moseley, Bluefield, W. Va.

Kentucky Service Co., Bloomfield, Ky.

E. R. Downs.

Kentucky-Tennessee Light & Power Co., Bowling Green, Ky.

J. M. Chapman.

Monongahela West Penn Public Service Co., Fairmont, W. Va.

A. B. Cole.

Potomac Edison Co., Hagerstown, Md.

C. H. Leatham.

The Southern Ohio Electric Co., Athens, Ohio.

F. M. McKay.

The Southern Ohio Public Service Co., Zanesville, Ohio.

C. M. Piper.

Northern Ohio Power & Light Co., Akron, Ohio.

H. C. Stephens, Akron, Ohio.

K. R. Lewis, Akron, Ohio.

W. H. Drew, Kent, Ohio.

F. H. Flickinger, Barberton, Ohio.

Eastern Division

New York State

New York Power & Light Corporation, Schenectady, N. Y.
 D. E. Blandy, Manager.
 Mr. Brayton (Glass Falls Division).
 Mr. Dennisen, Albany.
 R. G. Harvey.
 F. L. Budgett.
 A. J. VanSchrich.
 Frank Norman.
 Robert Johnson.
 Rochester Gas & Electric Corporation, Rochester, N. Y.
 L. S. Caple.
 Utica Gas & Electric Co., Poughkeepsie, N. Y.
 H. C. Fuller.
 Central Hudson Gas & Electric Co., Poughkeepsie, N. Y.
 J. H. Y. Kidd.
 New York State Gas & Electric Corporation, Ithaca, N. Y.
 H. H. Goss.
 Empire Gas & Electric Co., Geneva, N. Y.
 W. D. Wright.
 Niagara, Lockport & Ontario Power Co., Batavia, N. Y.
 John Costello.

Pennsylvania

Pennsylvania Power & Light Co., Allentown, Pa.
 Charles E. Oakes, Allentown, Pa.
 C. S. McElyea, Allentown, Pa.
 (22 district managers part time.)
 The Philadelphia Electric Co., Philadelphia, Pa.
 Howard Deshong, Delaware County Electric Co., Lansdowne, Pa.
 A. M. Getz, Delaware County Electric Co., 29 W. State St., Media, Pa.
 F. A. Alexander, Delta Electric Power Co., Delta, Pa.
 Scranton Electric Co., Scranton, Pa.
 E. W. Osborn.
 Luzerne County Gas & Electric Corporation, Kingston, Pa.
 Emil Brenner.
 Philadelphia Suburban Counties Gas & Electric Co., Norristown, Pa.
 Fred Naile, Norristown, Pa.
 Albert Benjamin, Pottstown, Pa.
 H. S. Brown, Bristol, Pa.
 Granville Fisher, Jenkintown, Pa.
 Metropolitan Edison Co., Reading, Pa.
 E. H. Bletner, Hanover, Pa.
 G. T. Seltzer, Lebanon, Pa.
 H. L. Rumble, Reading, Pa.
 C. H. Grabey, Reading, Pa.
 E. H. Ott, Easton, Pa.
 A. J. Althouse, Reading, Pa.
 Edison Electric Co., Lancaster, Pa.
 M. Huber Hess, Lancaster, Pa.
 Pennsylvania Electric Co., Johnstown, Pa.
 E. W. Matthews, Associated Gas & Electric System, Johnstown, Pa.
 Penn Central Light & Power Co., Altoona, Pa.
 C. L. East, Penn Power Co., Altoona, Pa.
 R. S. Rickabaugh, Huntingdon, Pa.
 B. C. Miller, Bedford Electric Light, Heat & Power Co., Bedford, Pa.
 N. R. Malone, Bedford Electric Light, Heat & Power Co., Bedford, Pa.
 W. S. Trout, Penn Central Light & Power Co., Lewistown, Pa.
 Laurry Brandt, Penn Central Light & Power Co., Ebensburg, Pa.
 E. F. Graver, Penn Central Light & Power Co., Patton, Pa.
 Harrisburg Light & Power Co., Harrisburg, Pa.
 J. C. Thompson, Harrisburg, Pa.
 Duquesne Light Co., Pittsburgh, Pa.
 A. J. Simon, East Pittsburgh, Pa.
 H. A. Braibin, East Pittsburgh, Pa.
 R. G. Oesterle, Pittsburgh, Pa.
 F. C. Niedt, Bellevue, Pa.
 B. F. Duncan, Sewickley, Pa.
 David Phillips, Beaver Falls, Pa.

A. R. Morrow, Beaver Falls, Pa.
 F. H. Stone, Pittsburgh, Pa.
 West Penn Power Co., Pittsburgh, Pa.
 L. E. Van Allen, West Penn Power Co., Greensburg, Pa.
 Citizens Light & Power Co., Oil City, Pa.
 Charles R. Thompson.
 John Fehrenbach, Titusville Light & Power Co., Titusville, Pa.
 R. H. Hill, Citizens Light & Power Co., Franklin, Pa.
 R. M. Stanton, Citizens Light & Power Co., Oil City, Pa.
 Pennsylvania-Ohio Power & Light Co., Youngstown, Ohio.
 L. B. Round, Pennsylvania Power Co., New Castle, Pa.
 R. Moses, Pennsylvania Power Co., Sharon, Pa.

Great Lakes Division

Wisconsin

The Milwaukee Electric Railway & Light Co., Milwaukee, Wis.
 A. B. Barfield.
 D. G. Barrus.
 H. C. Gardiner.
 O. J. Huegel.
 P. J. Rutzinski.
 August Strohm.
 J. F. Welch.
 Wisconsin Power & Light Co., Madison, Wis.
 E. R. Meachem, Madison, Wis.
 R. W. Walter, Madison, Wis.
 H. N. Gilbert, Beaver Dam, Wis.
 R. W. Farrington, Mineral Point, Wis.
 Fred Fuchs, Clintonville, Wis.
 R. W. Schmitz, Prairie du Sac, Wis.
 J. W. Porter, Cambridge, Wis.
 L. A. Wright, Beloit, Wis.
 J. G. Kaiser, Ripon, Wis.
 A. A. Kreuter, Berlin, Wis.
 Southern Wisconsin Electric Co., Lake Geneva, Wis.
 Herbert White.
 Northern States Power Co., Eau Claire, Wis.
 Robert Merrill.
 Wisconsin-Michigan Power Co., Appleton, Wis.
 R. Piper.
 Wisconsin Gas & Electric Co., Racine, Wis.
 D. J. Evans (in charge).
 Ralph Owen.
 (Other men working in Waukesha, Burlington, Whitewater, Fort Atkinson and Plymouth.)
 Peoples Wisconsin Hydro Electric Corporation, Amery, Wis.
 W. R. Heney.
 Wisconsin Valley Electric Co., Wausau, Wis.
 Ralph Drew.
 Madison Gas & Electric Co., Madison, Wis.
 F. W. Huels.
 Lake Superior District Power Co., Ashland, Wis.
 J. O. Forss.
 Willow River Power Co., Hudson, Wis.
 Alfred R. Schultz.

Illinois

Public Service Co. of Northern Illinois, Chicago, Ill.
 R. Boonstra.
 (2 other men assigned.)
 Central Illinois Public Service Co., Springfield, Ill.
 J. F. McCarthy.
 (4 other men devoting all their time.)
 Central Illinois Light Co., Peoria, Ill.
 J. A. Strawn.
 Middle West Utilities Co., Chicago, Ill.
 W. T. McCaskey, Director.

Michigan

The Detroit Edison Co., Monroe, Mich.
 John Flessner, Monroe, Mich.
 Mr. Mason, Mount Clemens, Mich.
 Consumers Power Co., Jackson, Mich.
 Eugene Holcomb.

Indiana

Indiana & Michigan Electric Co., South Bend, Ind.
 R. O. Probst.
 Earl A. Sherman.
 Indiana General Service Co., Hartford City, Ind.
 D. N. Merrell.
 Northern Indiana Power Co., Kokomo, Ind.
 F. O. Pence.
 Interstate Public Service Co., Indianapolis, Ind.
 O. B. Medalen.
 Terre Haute, Indianapolis & Eastern Traction Co., Terre Haute, Ind.
 W. D. Wallace.
 Attica Electric Co., Attica, Ind.
 J. R. Campbell, Newtown, Ind.

Middle West Division

Missouri

East Missouri Power Co., Troy, Mo.
 Roy Durham, Warrington, Mo.
 Irl Elliott, Troy, Mo.
 Empire District Electric Co., Joplin, Mo.
 Fred Morgan.
 Holt Electric Light Co., Holt, Mo.
 W. A. McGee.
 Liberal Light Co., Liberal, Mo.
 John T. Troughton.
 Missouri Gas & Electric Service Co., Lexington, Mo.
 J. H. Boggs.
 Maryville Electric Light & Power Co., Maryville, Mo.
 Ray L. Harrison.
 Missouri Edison Co., Louisiana, Mo.
 James Peterson.
 Missouri Power & Light Co., Kansas City, Mo.
 C. B. Owens, Kansas City, Mo.
 Mound City Electric Light & Ice Co., Mound City, Mo.
 A. L. Dobson.
 St. Joseph Railway, Light, Heat & Power Co., St. Joseph, Mo.
 J. H. Pritchard.
 Tarkio Electric Light & Power Co., Tarkio, Mo.
 William O. Briggs.
 Union Electric Light & Power Co., St. Louis, Mo.
 W. L. Jones, Webster Groves, Mo.
 E. T. Manley, Festus, Mo.
 G. W. Couch, Washington, Mo.
 H. Reeves, St. Charles, Mo.
 Kansas City Power & Light Co., Kansas City, Mo.
 H. A. Brunner, North Kansas City, Mo.
 N. T. Gault, Kansas City, Mo.
 Clyde H. Porter, Marshall, Mo.
 Harry Hill, Carrollton, Mo.
 O. T. Lewis, Glasgow, Mo.
 H. C. Dearing, Brunswick, Mo.
 Missouri Public Service Co., Pleasant Hill, Mo.
 H. R. Wade, Pleasant Hill, Mo.
 Charles Cole, Clinton, Mo.
 A. G. Smith, Nevada, Mo.
 W. P. Evans, Pleasant Hill, Mo.
 James Chapman, Lee's Summit, Mo.
 W. P. Dunlap, Warrensburg, Mo.

Nebraska

Iowa-Nebraska Light & Power Co., Lincoln, Neb.
 D. L. Renner, Lincoln, Neb.

Iowa

Iowa Railway & Light Corporation, Cedar Rapids, Iowa.
 H. Startzman, Cedar Rapids, Iowa.
 F. Flack, Marion, Iowa.
 C. Carter, Marshalltown, Iowa.
 E. A. Grunawalt, Toledo, Iowa.
 R. E. Neff, Perry, Iowa.

Interstate Power Co., Dubuque, Iowa.
 (See also listing under North Central Division)
 Frank Kiley, Blue Earth, Minn.
 P. J. Nee, Dubuque, Iowa.
 Joe Riden, Albert Lea, Minn.
 F. P. Johnston, Albert Lea, Minn.
 N. W. Christopherson, Albert Lea, Minn.
 A. J. Dupont, Dubuque, Iowa.
 Peoples Gas & Electric Co., Mason City, Iowa.
 H. A. Harpster.
 Iowa Public Service Co., Fort Dodge, Iowa.
 G. A. Neal.
 Des Moines Electric Light Co., Des Moines, Iowa.
 Ira Steele.
 Charles Clark.

New England Division

Central Maine Power Co., Augusta, Me.
 John W. Leland.
 Narragansett Electric Lighting Co., Providence, R. I.
 Fred Horton.
 Hartford Electric Light Co., Hartford, Conn.
 George H. Allen.
 Edison Electric Illuminating Co., Boston, Mass.
 N. D. Herrick.
 Edison Electric Illuminating Co., Brockton, Mass.
 Fred S. Mason.
 Gardner Electric Light Co., Gardner, Mass.
 C. A. Ware.
 Manchester Traction, Light & Power Co., Manchester, N. H.
 J. B. Smith.
 Worcester Suburban Electric Co., Uxbridge, Mass.
 R. H. Alton.
 Derry Electric Co., Derry, N. H.
 Portsmouth Power Co., Portsmouth, N. H.
 F. W. Randall (both above companies).
 Fall River Electric Light Co., Fall River, Mass.
 H. H. Bodge.
 Grafton County Electric Light & Power Co., White River Junction, Vt.
 W. F. Gray.
 Newport Electric Corporation, Newport, R. I.
 James H. Hagerty.
 Fall Mountain Electric Co., Bellows Falls, Vt.
 N. A. Clark.
 New Bedford Gas & Edison Light Co., New Bedford, Mass.
 David W. Beaman.
 Connecticut Light & Power Co., Hartford, Conn.
 Paul Thompson.

North Central Division

Northern States Power Company, Minneapolis, Minn.
 C. P. Wagner, general charge of all divisions of company, Minneapolis, Minn.
 G. G. Napier, St. Paul, Minn.
 R. E. Nelson, Stillwater, Minn.
 L. K. McLeland, St. Cloud, Minn.
 O. M. Hoxie, Mankato, Minn.
 A. G. Buchholz, Minot, N. D.
 George A. Hult, Sioux Falls, S. D.
 C. G. Engstrom, Hutchinson, Minn.
 H. F. Brossard, Faribault, Minn.
 W. J. Flynn, Faribault, Minn.
 Union Light, Heat & Power Co., Fargo, N. D.
 J. F. McGuire.
 Red River Power Company, Grand Forks, N. D.
 P. J. Montgomery.
 Minnesota Power & Light Co., Duluth, Minn.
 A. S. Grant.
 Ottertail Power Co., Fergus Falls, Minn.
 Carl Johnson.
 Gunderson Electric Co., Kenyon, Minn.
 W. J. Flynn.
 Interstate Power Co., Dubuque, Iowa.
 Frank Kiley, Blue Earth, Minn.
 Joe Riden, Albert Lea, Minn.
 F. P. Johnston, Albert Lea, Minn.
 N. W. Christopherson, Albert Lea, Minn.

St. Croix Falls, Minnesota Improvement Co.
P. C. Weinhardt.
Diechen Electric Construction Co., Albert Lea, Minn.
Eastern Minnesota Power Co., Pine City, Minn.
N. K. Nelson.
Northwestern Public Service Co., Huron, S. D.
C. J. Strike.
Mississippi Valley Public Service Co., Winona, Minn.
L. A. Grettum.
Union Public Service Co., Canby, Minn.
C. A. Sorenson.

Northwest Division

Pacific Power & Light Co., Toppenish, Wash.
George W. Hibbert.
Eastern Oregon Light & Power Co., Masonic Bldg., Baker, Ore.
J. P. Lottridge.
Puget Sound Power & Light Co., Electric Bldg., Seattle, Wash.
J. C. Scott.
California-Oregon Power Co., Medford, Ore.
J. C. Thompson.
Portland Electric Power Co., Salem, Ore.
W. M. Hamilton.
Northwestern Electric Co., Vancouver, Wash.
T. H. Robbins.
Gray's Harbor Railway & Light Co., Aberdeen, Wash.
H. G. Kelsey.
Idaho Power Co., Boise, Idaho.
Hobart Beresford.
Mountain States Power Co., Albany, Ore.
H. C. Wells.
Washington Waterpower Co., Spokane, Wash.
J. F. Farquhar.
Utah Power & Light Co., Logan, Utah.
E. R. Owen.

Pacific Coast Division

Southern Sierras Power Co., Riverside, Cal.
Albert Cage.
Coast Counties Gas & Electric Co., Santa Cruz, Cal.
R. L. Cardiff, Santa Cruz, Cal.
O. A. Brugler, Watsonville, Cal.
H. B. McLaughlin, Hollister, Cal.
R. G. Barnett, Gilroy, Cal.
Great Western Power Co. of California, San Francisco, Cal.
R. A. Sharon.
H. E. Brillhart, Sacramento, Cal.
T. E. Ward, Napa, Cal.
F. W. Mielenz, St. Helena, Cal.
Pacific Gas & Electric Co., San Francisco, Cal.
R. E. Fisher and Norman R. Sutherland, San Francisco, Cal.
James F. Pollard, Salinas, Cal. (Coast Valleys Div.)
E. C. Johnson, Marysville, Cal. (Colgate Div.)
C. R. Gill, Colusa, Cal. (Colusa Dist.)
I. B. Adams, Chico, Cal. (De Sabla Div.)
H. M. Cooper, Auburn, Cal. (Drum Div.)
L. H. Hartsock, Nevada City, Cal. (Nevada Dist.)
J. V. Kyle, Auburn, Cal. (Placer County Dist.)
L. H. Newbert, Oakland, Cal. (East Bay Div.)
J. H. Pape, Berkeley, Cal. (Berkeley Dist.)
H. C. Ross, Fresno, Cal. (Fresno Div.)
H. L. Jackman, Eureka, Cal. (Humboldt Div.)
H. G. Ridgway, San Rafael, Cal. (North Bay Div.)
L. J. Peterson, Petaluma, Cal. (Petaluma Dist.)
C. D. Clark, Napa, Cal. (Napa Dist.)
C. D. Clark, Vallejo, Cal. (Vallejo Dist.)
M. G. Hall, Santa Rosa, Cal. (Santa Rosa Dist.)
E. W. Florence, Sacramento, Cal. (Sacramento, Div.)
C. E. Sedgwick, Dixon, Cal. (Solano Dist.)
J. W. Coons, Woodland, Cal. (Yolo Dist.)
Henry Bostwick, San Francisco, Cal. (San Francisco Div.)
H. B. Heryford, Stockton, Cal. (San Joaquin Div.)
W. E. Eskew, Jackson, Cal. (Electra Dist.)
J. H. Fagg, Stockton, Cal. (Stockton Dist.)
Charles H. Noack, Sonoma, Cal. (Tuolumne Dist.)
John D. Kuster, San Jose, Cal. (San Jose Div.)

W. T. Kellogg, Redwood City, Cal. (Redwood Dist.)
G. R. Milford, Red Bluff, Cal. (Shasta Div.)
Stephen Goin, Willows, Cal. (Willows Dist.)
Charles Hughes, Red Bluff, Cal. (Red Bluff Dist.)
San Joaquin Light & Power Corporation, Fresno, Cal.
J. B. Carter, Fresno, Cal.
J. P. McElroy, Fresno, Cal.
D. L. Wishon, Bakersfield, Cal.
J. P. Kastl, Bakersfield, Cal.
E. F. Millard, Bakersfield, Cal.
W. H. Jahant, Wasco, Cal.
F. C. Carroll, Corcoran, Cal.
H. G. Redfern, Dinuba, Cal.
M. D. Wheat, Dinuba, Cal.
P. B. Wilson, Fresno, Cal.
N. T. Eichelberger, Fresno, Cal.
G. E. Zelhart, Fresno, Cal.
C. H. Eaton, Fresno, Cal.
Thomas Hancock, Los Banos, Cal.
J. E. Barrett, Madera, Cal.
G. V. Footman, Madera, Cal.
R. Casad, Merced, Cal.
M. E. Herron, Merced, Cal.
E. H. Stahl, San Joaquin, Cal.
DeWitt Scott, San Joaquin, Cal.
H. H. Young, Selma, Cal.
W. L. Henderson, Selma, Cal.
O. A. Kommers, Taft, Cal.
J. C. Berry, Taft, Cal.
T. K. Holmes (Midland Counties Public Service Corporation), Coalinga, Cal.
C. J. Kelly (Midland Counties Public Service Corporation), San Luis Obispo, Cal.
R. D. DeChaine (Midland Counties Public Service Corporation), San Luis Obispo, Cal.
L. L. Turnbull (Midland Counties Public Service Corporation), San Luis Obispo, Cal.
A. D. Church (Midland Counties Public Service Corporation), Santa Maria, Cal.
V. F. Alexander (Midland Counties Public Service Corporation), Santa Maria, Cal.
San Diego Consolidated Gas & Electric Co., San Diego, Cal.
K. B. Ayres, San Diego, Cal.
William A. Lambert, Coronado, Cal.
J. P. Brown, La Jolla, Cal.
Percy Fisher, Escondido, Cal.
E. R. Hollingsworth, La Mesa, Cal.
A. R. Whisler, Oceanside, Cal.
George P. Winn, Chula Vista, Cal.
Southern California Edison Co., Los Angeles, Cal.
A. I. Whitehead, Alhambra, Cal.
W. J. Crock, Compton, Cal.
R. C. Hanna, Covina, Cal.
P. V. Moffat, Delano, Cal.
Frank Hamilton, Fullerton, Cal.
John R. White, Hanford, Cal.
Dale M. Peters, Huntington Beach, Cal.
C. N. Elgan, Inglewood, Cal.
L. S. Tudor, Lancaster, Cal.
H. V. Busby, Lindsay, Cal.
W. P. Graef, Long Beach, Cal.
Fred Schwartz, Monrovia, Cal.
Myron McNeal, Montebello, Cal.
H. A. Brody, Oxnard, Cal.
A. B. Wollaber, Pasadena, Cal.
C. E. Houston, Pomona, Cal.
A. W. Frost, Porterville, Cal.
H. S. Williamson, Redlands, Cal.
C. W. Koiner, Redondo Beach, Cal.
H. J. Moulton, San Bernardino, Cal.
Ray Whitson, San Fernando, Cal.
W. L. Deimling, Santa Ana, Cal.
R. R. Walbridge, Santa Barbara, Cal.
C. E. Hewes, Santa Monica, Cal.
L. S. Lothridge, Santa Paula, Cal.
R. E. Bacon, Tulare, Cal.
Nicholas Hearne, Jr., Ventura, Cal.
C. H. Coulter, Vernon, Cal.
D. H. Rowan, Visalia, Cal.
P. J. Denninger, Whittier, Cal.

Southern Sierras Power Co., Riverside, Cal.

J. E. King, El Centro, Cal.
C. C. Ernst, El Centro, Cal.
H. A. Van Loon, Bishop, Cal.
G. W. Clarkson, Bishop, Cal.
P. H. Yelton, Randsburg, Cal.
H. W. Mosier, Barstow, Cal.
F. C. Hubbard, Victorville, Cal.
R. Neuman, San Bernardino, Cal.
J. C. Smith, Rialto, Cal.
F. C. Sollars, Riverside, Cal.
C. A. Grabendike, Perris, Cal.
B. F. Himes, Hemet, Cal.
L. W. Bentley, Elsinore, Cal.
A. W. Briggs, Corona, Cal.
D. F. Cavanaugh, Blythe, Cal.
L. E. Cramer, Palm Springs, Cal.
J. G. Nusbaum, Coachella, Cal.
K. A. Cassett, Calipatria, Cal.
D. S. Bromley, Brawley, Cal.
F. E. Lucking, Holtville, Cal.
W. T. Johnson, Calexico, Cal.
Yuma Utilities Company.
T. F. Quigley, Yuma, Ariz.
A. G. Cage, Riverside, Cal.

Rocky Mountain Division

Public Service Company of Colorado, Denver, Colo.
G. B. Buck.
Western Colorado Power Co., Durango, Colo.
J. A. Clay.
Western Colorado Power Co., Montrose, Colo.
J. A. Clay.
Albuquerque Gas & Electric Co., Albuquerque, N. M.
E. M. Conwell.
Deming Ice & Electric Co., Deming, N. M.
K. W. Kissick.

Home Gas & Electric Co., Greeley, Colo.

Luke R. Storey.
S. W. Public Service Co., Roswell, N. M.
F. A. Herring.

Southeastern Division

Alabama Power Company, Birmingham, Ala.
H. M. Weathers, in general charge.
E. C. Easter, in charge of field work.
J. M. Herron, Jr., charge of Southern Division.
S. R. Gibbons, in charge of Mobile Division.
J. F. Hixon, in charge of Eufaula Division.
J. C. Tyson, in charge of western division.
Georgia Railway & Power Company, Atlanta, Ga.
L. W. Gray.
Gulf Power Company, Pensacola, Fla.
W. W. Moseley.
South Carolina Power Company, Charleston, S. C.
Percy Miley.
North Carolina Public Service Co., Greensboro, N. C.
George Wilkens.
Memphis Power & Light Co., Memphis, Tenn.
J. J. Brennan.
Nashville Railway & Light Co., Nashville, Tenn.
C. P. Little.
Southern Georgia Power Co., Albany, Ga.
E. H. Keaton.
Columbus Electric & Power Co., Columbus, Ga.
E. H. Keaton.
Carolina Power & Light Co., Raleigh, N. C.
William Bailey.
Bristol Gas & Electric Co., Bristol, Tenn.
C. W. Ferguson.

Southwestern Division

Mississippi Power Company, Gulfport, Miss.
E. W. Trussell.
Oklahoma Gas & Electric Company, Oklahoma City, Okla.
Roy Hayman.

DEVELOPING ELECTRIC SERVICE FOR THE FARM

As Exemplified by the Organizations and
Methods of Alabama Power Company

Serial Report of the
RURAL ELECTRIC SERVICE COMMITTEE

1928-1929

July, 1929

NATIONAL ELECTRIC LIGHT ASSOCIATION

420 Lexington Avenue

NEW YORK CITY

1st Printing
7-29 5M

RURAL ELECTRIC SERVICE COMMITTEE—1928-1929

SCOPE: To make a study of the problems connected with rural electric service, to collect accurate information on the cost of this service to the utility; to determine the value of this service to the rural customers; to analyze the various rules, methods of financing and forms of rural rates now being used; to assist in the development of farm equipment suitable for electric drive; to assist in determining the proper standards of rural line construction and to assist the Committee on the Relation of Electricity to Agriculture in carrying on this work; to assist in the development of rural service departments in public utility organizations; to assist in the building of electric power load on the farm.

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 Vice-Chairman, EUGENE HOLCOMB, Consumers Power Co, Jackson, Mich
 F A BELDEN, The Edison Electric Illuminating Co, Boston, Mass
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 C H CHURCHILL, New York Power & Light Corp, Schenectady, N Y
 JOHN M COSTELLO, Niagara, Lockport & Ontario Co, Batavia, N Y
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L A McARTHUR, Pacific Power & Light Co, Portland, Ore
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 J F OWENS, Oklahoma Gas & Electric Co, Oklahoma City, Okla
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 C V SORENSON, Attica Electric Co, Attica, Ind
 PHILIP B SHAW, National Electric Power Co, New York, N Y
 E N STRAIT, Byllesby Engineering & Management Corp, Chicago, Ill
 NORMAN R SUTHERLAND, Pacific Gas & Electric Co, San Francisco, Cal
 STANLEY TABER, Iowa-Nebraska Light & Power Co, Lincoln, Neb
 E A WHITE, 58 E Washington St, Chicago, Ill
 JOHN S WISE, JR, Pennsylvania Power & Light Co, Allentown, Pa

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 Eastern—C E OAKES, Pennsylvania Power & Light Co, Allentown, Pa
 East Central—C I WEAVER, Ohio Edison Co, Springfield, Ohio
 Great Lakes—EUGENE HOLCOMB, Consumers Power Co, Jackson, Mich
 Middle West—W R McGEACHIN, Iowa-Nebraska Light & Power Co, Lincoln, Neb
 New England—R H ALTON, Worcester Suburban Electric Co, Uxbridge, Mass

North Central—C P WAGNER, Northern States Power Co, Minneapolis, Minn
 Northwest—J C SCOTT, Puget Sound Power & Light Co, Seattle, Wash
 Pacific Coast—
 Rocky Mountain—J A CLAY, Western Colorado Power Co, Durango, Colo
 Southeastern—H M WEATHERS, Alabama Power Co, Birmingham, Ala
 Southwestern—O A JENNINGS, Oklahoma Gas & Electric Co, Oklahoma City, Okla

CONTENTS

	PAGE
Rural Electric Service in Alabama.....	iv
By Thomas W. Martin, President, Alabama Power Company	
The Agriculture of Alabama.....	1
Statistical Picture	2
Rural Electric Development in Alabama.....	3
Organization and Work of Rural Service Section.....	4
Outline of Methods of Procedure.....	5
Use of Newspaper Advertising.....	6
Service Classification "E".....	7-10
Application for Service Form.....	11
Customer Deposit Card.....	12
Selling Equipment to Rural Customers.....	12
Meter Reading and Billing Rural Customers.....	13
Developing Appreciation of Rural Electric Service.....	13
Results and Effects	13
Rural Lines and Systems.....	14
I—Types of Systems.....	14
II—Line Construction	14
III—Secondary Service	14

Rural Electric Service in Alabama

By THOMAS W. MARTIN, *President*
Alabama Power Company

ALABAMA POWER COMPANY, within the past few years, has invested more than \$2,000,000.00 to enable it to furnish rural electric energy and is now serving more than 6000 Alabama farmers. This statement is made with considerable pride for back of it are plans, purposes and efforts that have been an integral part of the Company's life and growth.

Our trade slogan—"Serving Farm, Factory and Fireside"—puts the farm in a leading place in the Company's ideal of service. In working to this ideal, the necessities of sound financing and healthy growth, governing our Company as they do all successful utilities, required that the service be first extended to cities and thickly populated industrial centers. As these objectives were attained, it was possible to widen the circle and reach farther and farther into the rural sections. This was most opportune for farm life needed a revivifying touch if a balanced ratio between agricultural and industrial pursuits, urban and rural life, was to be maintained.

Electrified farm operation was the contribution the Company began to make and is making towards the relief of this situation. A happy and prosperous, contented and progressive farm home radiates a beneficent and inspiring influence that is reflected in the life of the entire State as well as in the local community. Abundant electric energy at reasonable rates, by removing household drudgery, making profits possible and by affording leisure for the enjoyment of the cultural agencies it brings, gives the farmer the opportunity to have such a home.

The use of household appliances on the 256 lines now in operation is quite general. The application of electric power in farm operations is constantly increasing in scope, as evidenced by the installations being made.

While our rural power revenue is not as yet making a satisfactory return on the investment, we are quite hopeful that the business will be built up to self-sustaining proportions within a reasonable time. Viewing this work from both the economic and social standpoint, we feel fully justified in continuing it as an integral part of our program of service, confident that it is contributing to the prosperity of Alabama.

DEVELOPING ELECTRIC SERVICE FOR THE FARM

AS EXEMPLIFIED BY THE ORGANIZATION AND METHODS OF ALABAMA POWER COMPANY

In order to make available practical information on how electric light and power companies may organize to develop electric service on the farm, the Rural Electric Service Committee has undertaken issuance of a series of reports which reflect in detail how this class of business is being handled by a number of companies.

This is the second of the series. It portrays in detail the rural electric service department of the Alabama Power Company, Birmingham, Ala.; how it was organized; how it fits in with the rest of the organization, how it operates, and the results achieved. In the near future similar reports regarding rural electric service departments in other companies will be issued.

It should be understood that the Rural Electric Service Committee of the National Electric Light Association in presenting these reports does not pretend to recommend the plan of organization and operation of any one company. It merely presents the methods of these companies for what they may be worth to others undertaking the organization and operation of such departments.

THE AGRICULTURE OF ALABAMA

Alabama is divided into seven agricultural divisions, based on general soil characteristics, as shown in Fig. 1. While certain of these divisions lend themselves particularly well to specialized agricultural pursuits—winter and spring vegetables in the southern part of the Lower Coastal Plain, and dairying and other livestock in the Black Belt that is well adapted to good, low-cost permanent pasture—the long growing season and the versatility of the

soil adapts practically the entire State to a diversified farming program.

Cotton is generally adapted to the entire State and is the chief money crop. Experimental studies and experience have developed economical methods of cotton production under boll-weevil conditions. Therefore, cotton will continue to be the major money crop, but there is a trend already under rapid development to supplement the cotton crop with more farm products, both for local consumption and for out of State markets. The production of dairy products, poultry products, beef cattle, hogs, fruits, vegetables, pecans and other crops, both on specialized farms and as supplementary to cotton and corn production, is advancing rapidly.

The State Agricultural Experiment Station, Auburn, Ala., has, through the development of specific information, laid the foundation for vast improvements in soil fertilization, crop varieties, rotation and methods of cultivation. This is resulting in increased production per acre and per man, and a reduced cost of production per unit. The experimental work is being made more comprehensive and effective through the establishment of branch experimental stations and fields in the different agricultural sections of the State.

Through the work of the Agricultural Extension Service, which directs the efforts of the County Agricultural and Home Demonstration agents, recently developed information relating to better agricultural practices is disseminated to the farmers throughout the State.

The State Department of Agriculture cooperates in the dissemination of information to the farmers, and through its inspection, standardization and other regulatory activities is having a profound influence upon the production and marketing of the State's agricultural products.

The Farm Bureau is, through its cooperative marketing and purchasing associations, rendering agriculture a great aid, not only in the handling of products, but also in establishing the cooperative idea among farmers.

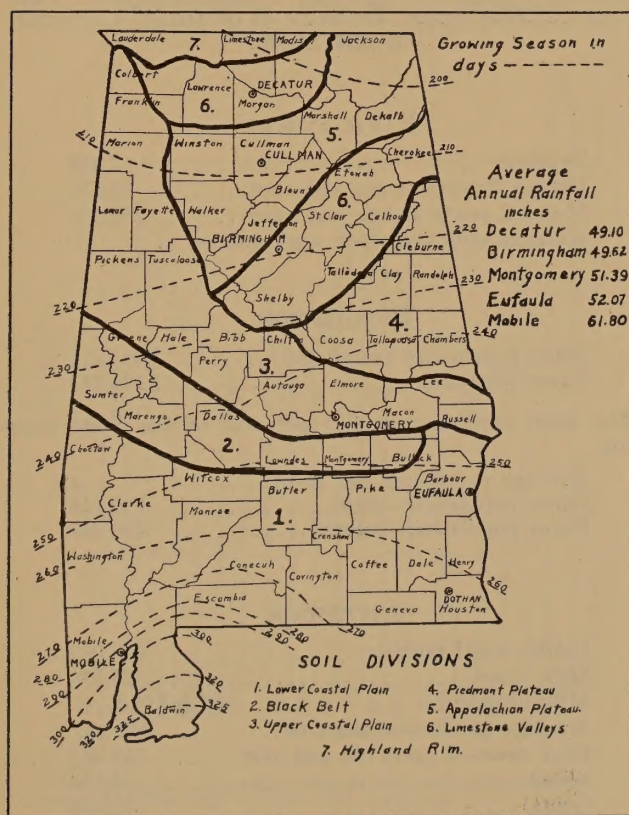


FIG. 1—STATE OF ALABAMA, SHOWING SOIL DIVISIONS, RANGE IN GROWING DAYS, AND AVERAGE RAINFALL.

Industries of the State have become more familiar with the agricultural problems and are cooperating with the farmers very effectively, especially in the distribution of agricultural products for local consumption.

These activities, together with the increased industrialization of the State, are creating a trend toward improved farming methods and a more prosperous agriculture.

Statistical Picture of Alabama Agriculture

Based Largely on Data Collected by U. S. Bureau of Census—1925

Land area of State.....	32,818,560 acres
Land area in farms.....	16,739,139 acres
Per cent of land area in farms.....	51.0

CLASSIFICATION OF FARM LAND

	Acres	Per Cent of Farm Land
Crop land	7,691,713	45.9
Pasture land	3,544,351	21.2
Woodland—not pasture.....	3,855,958	23.1
All other land in farms.....	1,647,114	9.8

FARMS BY SIZE

	Farms by Size	Per cent of Total
Under 3 acres.....	102	0.04
3 to 9 acres.....	9,807	4.10
10 to 19 acres.....	26,262	11.05
20 to 49 acres.....	104,030	43.75
50 to 99 acres.....	53,667	22.60
100 to 174 acres.....	27,885	11.76
175 to 259 acres.....	8,255	3.50
260 to 499 acres.....	5,356	2.25
500 to 999 acres.....	1,616	0.68
1000 to 4999 acres.....	632	0.26
5000 acres and over.....	19	0.01

Total farms in State.....	237,631
Average size farm.....	70.4 acres

FARMERS—COLOR AND TENURE

		Per cent of Total
White farm operators.....	152,310	64.2
Colored farm operators.....	85,321	35.8
Farm owners—white.....	78,614	33.1
Farm owners—colored.....	14,782	6.2
Tenants—white	73,696	31.0
Tenants—colored	70,539	29.7

Percentage of farm owners, 39.3.

FARM VALUES

Land	\$308,663,620
Buildings	106,195,027
Implements and machinery.....	23,850,657
Livestock	62,031,018
All farm property.....	500,740,322
Average value per farm.....	2,107
Average value per acre.....	30

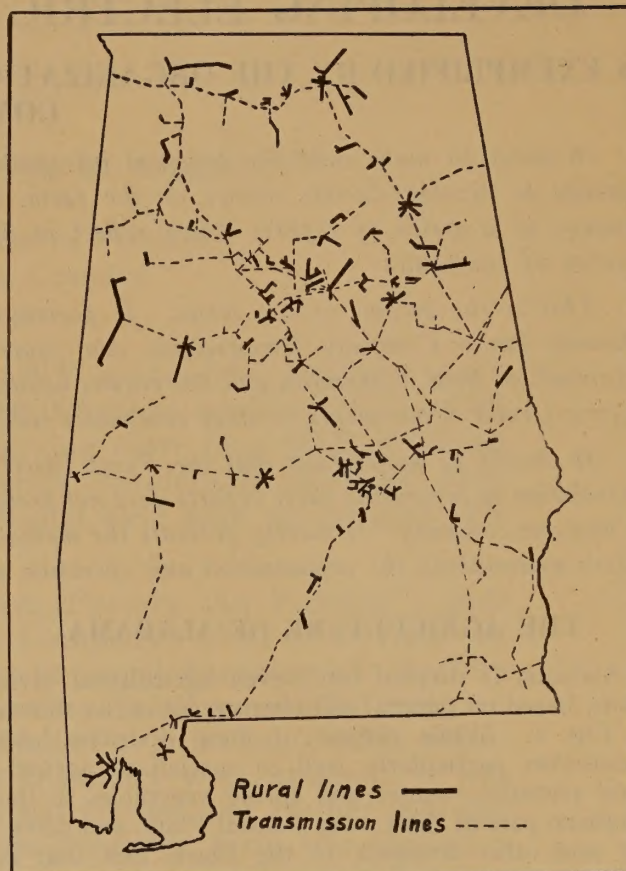


FIG. 2—DISTRIBUTION OF RURAL LINES AND THE TRANSMISSION SYSTEM OF ALABAMA POWER COMPANY. THE COMPANY HAS RURAL LINES IN 44 OF THE 67 COUNTIES OF THE STATE.

FARM POWER

Tractors	2,465
Horses 2 years of age and over.....	82,778
Mules 2 years of age and over.....	298,636
Average crop acres per work animal...	20

POPULATION

State population (estimated).....	2,453,214
Farm population	1,166,432

The farm population is 47.5 per cent of the State population.

Average population per farm.....	4.9
Farm population—white.....	730,145
Farm population—colored.....	436,287

LIVESTOCK

Cattle—total number	822,093
Milk cows	325,578
Milk production	95,364,944 gal.
Average production per cow.....	293 gal.
Beef cows—2 years old and over.....	165,065
Sheep	55,554
Goats	72,469
Swine	826,833
Chickens	6,284,460
Egg production	19,466,770 doz.
Chickens raised	9,527,321

CROPS

	Acres	Average Yield per Acre
Corn	2,788,733	12.0 bushels
Wheat	6,070	10.0 bushels
Oats	84,853	15.0 bushels
Sorghum	23,867	....
Peanuts	253,827	19.5 bushels
Velvet beans.....	310,872	....
Navy beans.....	2,109	....
Hay	508,949	.73 tons
Cotton	2,948,072	.333 bales
Sugar cane and sorghum for syrup	35,020	....
Potatoes, white.....	16,695	98.0 bushels
Sweet potatoes and yams.....	48,443	77.0 bushels
Strawberries	3,125	....
Watermelons	20,608	....
Vegetables	8,198	....

Trees

Apple trees of bearing age...	798,070	12.50 bush. per tree
Apple trees not of bearing age.	426,342	
Peach trees.....	1,849,990	
Orange trees—bearing age....	262,689	
Orange trees—not bearing age.	359,126	
Pecan trees—bearing age.....	303,399	
Pecan trees—not bearing age.	406,271	
Other fruit trees.....	317,034	

Vines

Grape vines.....	239,221
Value of all farm crops, \$181,026,321.	

COMMUNITY ENTERPRISES

Gins	1,525
Creameries and cheese plants.....	76
Canneries (1927).....	18

STATE HIGHWAYS

The state highway system, which is under the supervision of the State Highway Department, comprises approximately 5600 miles of road. This is less than 10 per cent of the total road mileage of the State, and is classified as follows:

	Miles of Road
Paved	700
Gravel	1,705
Sand-clay	844
Improved dirt.....	768
Unimproved dirt	1,576

RURAL ELECTRIC DEVELOPMENT IN ALABAMA

The rural electric development by Alabama Power Company includes the expansion of electric service outside the corporate limits of towns and cities, serving less than twenty customers per mile of distribution line, and does not refer to purely farm service. On Jan. 1, 1929, the company was serving 5511 rural customers from 836.5 miles of lines, an average density of 6.8 customers per mile

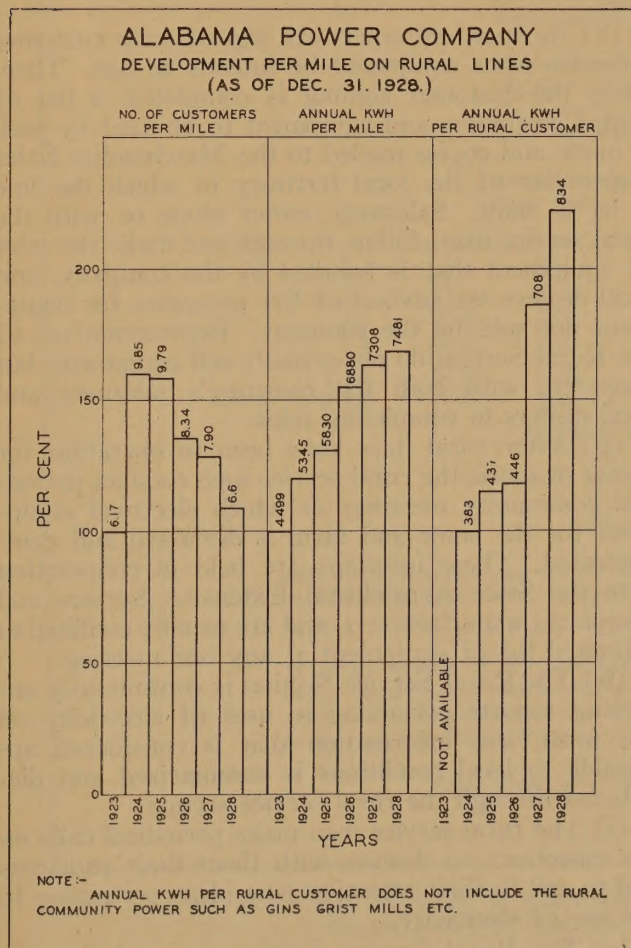


FIG. 3—DEVELOPMENT PER MILE ON RURAL LINES—ALABAMA POWER COMPANY.

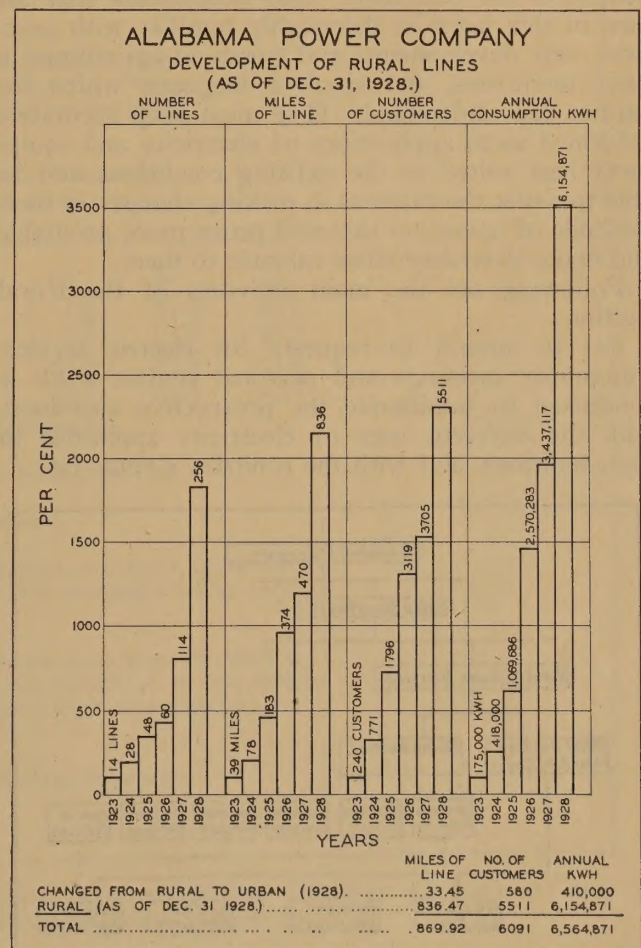


FIG. 4—DEVELOPMENT OF RURAL LINES—ALABAMA POWER COMPANY.

of line. Approximately 70 per cent of the rural customers served at the date were farmers, and the company was serving 2000 farmers from distribution lines that are not classed as rural.

ORGANIZATION AND WORK OF RURAL SERVICE SECTION

The rural electrification work of the Alabama Power Company is organized as a section of the Rural and Towns Division of the Sales Department. At present the personnel of this section consists of a chief agricultural engineer, an assistant agricultural engineer and four agricultural engineers assigned to operating division offices. It is planned to expand this personnel to include one agricultural engineer for each division office, and ultimately when the number of rural customers increases sufficiently, it is expected that agricultural engineers will be assigned to district offices.

The work of the Rural Section consists primarily of developing the electrical consciousness in rural communities, which have requested electric service, to the point that there is available a sufficient load to justify the extension of new rural lines and assisting farmers and others already served in reaching the ultimate economic limit for uses of electricity. In this work there is a special effort made to recommend only such uses of electricity that will be a benefit to the customer. This necessitates that the men in this work be thoroughly familiar with practices, new developments and trends in agriculture in their territories, and speak a language which the farmer can understand. They must keep accurately informed as to applications of electricity and equipment best suited to the existing conditions and be able to assist the farmers in making changes in their methods of operation that will prove more profitable and make electricity more valuable to them.

Following are the main activities of the Rural Section:

(a) In answer to requests for electric service, community meetings and personal contact work is conducted to familiarize the prospective customers with the different uses of electricity applicable to the conditions, and with the company's rural rate.

(b) If the results of this preliminary work indicate that electric service is feasible to the community requesting service, a complete commercial survey is made including map of proposed line with prospective customers and loads indicated.

(c) If the preliminary work indicates that the proposed line is not feasible at that time, the educational efforts are continued periodically at the request of the people until sufficient load is developed. In many instances this activity continues as long as two years or more before the project is developed to the point of signing customers.

(d) Where the farm operations are of considerable volume the rural service men make a detailed analysis and prepare a written report including time, labor and costs with and without electric service for each operation to assist the farmer in his problems. This is done for both prospective and existing customers.

(e) After the preliminary work is completed and surveys indicate that the extension will be feasible both to the company and the proposed customers, an effort is made to sign the customers for service, at which time the explanations are continued at considerable length with each prospective customer. Rural customers are signed by both the rural service men and by a crew of men in the Towns Section, who devote their entire efforts to making surveys and signing customers in new towns and on rural lines.

(f) As rural customers are signed, each customer indicates what equipment he intends to use. Then, when the customer signing is completed, a list of signed customers and equipment to be used by each is made and copies mailed to the Merchandise Sales Supervisor of the local territory in which the line is to be built. Salesmen, either alone or with the rural service man, follow through and make the sales of equipment that is handled by the company, and local dealers are advised of live prospects for equipment not sold by the company. Representatives of the Rural Section do not actually sell equipment, but cooperate with both the company's salesmen and local dealers in completing sales.

(g) After rural lines have been in operation for a year or more, the rural service men conduct periodical community meetings at which electrical equipment for the home and farm is discussed and demonstrated. These meetings are held in cooperation with the State Agricultural Extension Service and equipment manufacturers, and are usually confined to a limited list of equipment at any one meeting.

(h) The Rural Service Section is continuously analyzing reports pertaining to uses of electricity on the farm, and information that is considered applicable to local conditions is summarized and distributed through the rural service section.

(i) The rural service men make periodical calls on the customers to discuss with them their problems and to call to their attention new ideas pertaining to the use of electricity.

(j) The Rural Service Section aggressively presents to manufacturing companies equipment needs that are not at present met, and cooperates with the

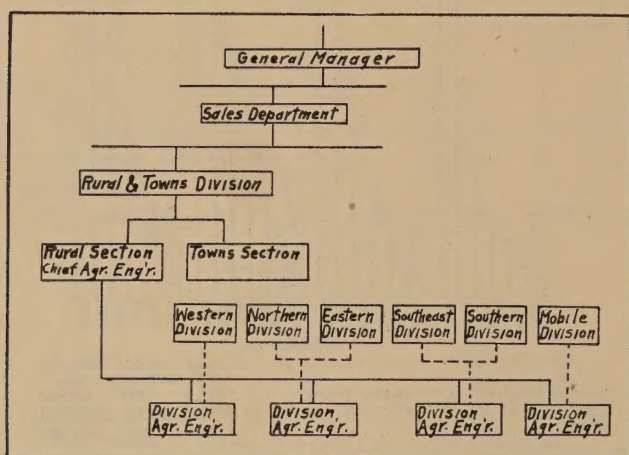


FIG. 5—ORGANIZATION OF ALABAMA POWER COMPANY FOR RURAL ELECTRIC DEVELOPMENT.

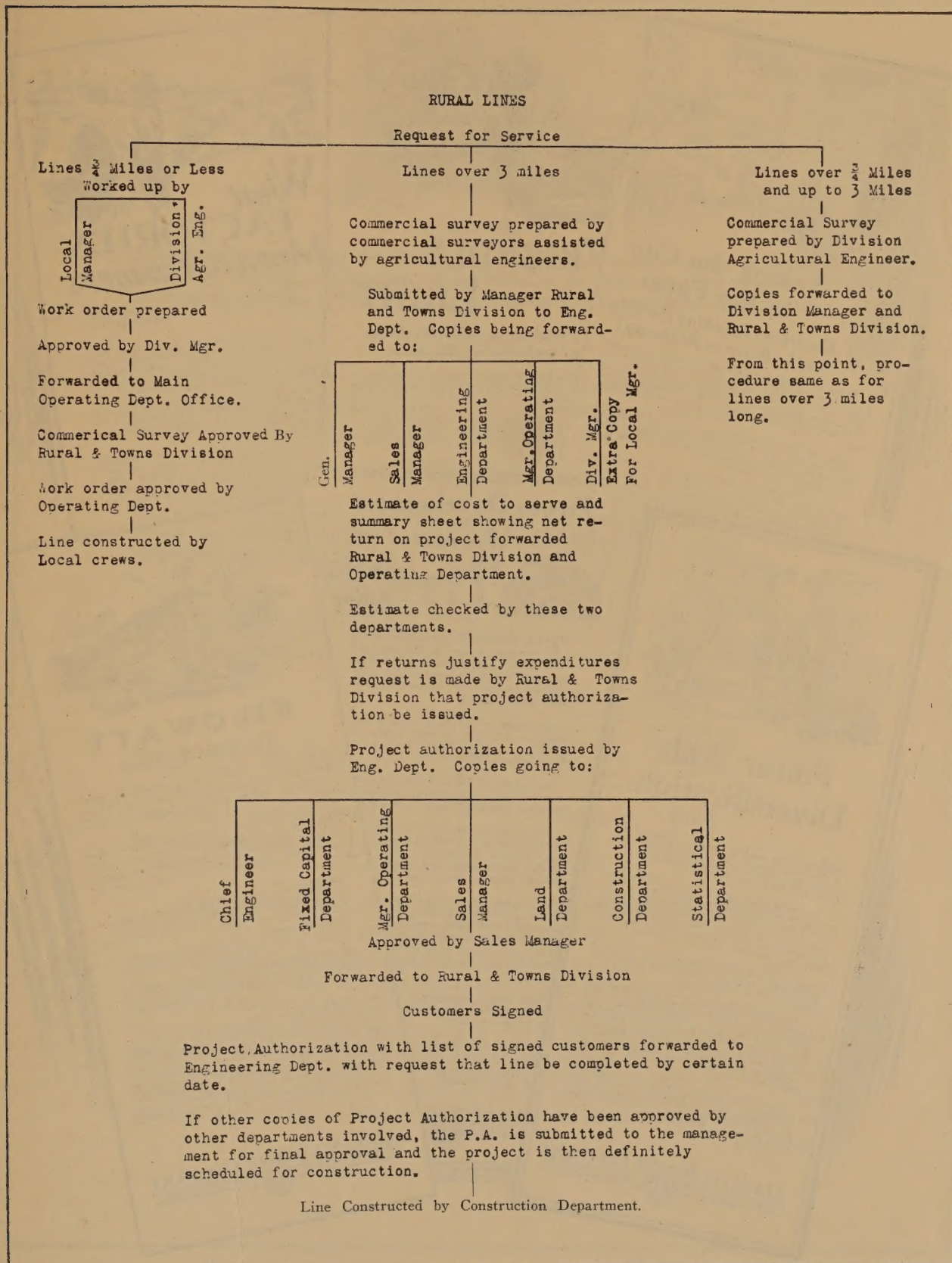


FIG. 6—OUTLINE OF THE METHODS OF PROCEDURE WITHIN ALABAMA POWER COMPANY INCIDENT TO THE ESTABLISHING OF ELECTRIC SERVICE IN A RURAL COMMUNITY.



Taking the City to the Farm

Electricity is taking the City to the Farm in Alabama!

LESS than 5 years ago Alabama had no rural electric service lines. Today, 175 rural lines, totaling 643 miles in length, serve 6,000 customers. Four thousand additional rural customers are served by lines of other classes, and 30 other rural lines, 191 miles in length, are authorized for construction.

Rural electrification in Alabama is not a fad. Its progress to date has been on a sound economic basis. Service has not been and will not be extended where the cost of doing so will burden rural or other customers.

But on this basis of sound economics, electricity is destined to play the part of a vitalizing force in the transition of agriculture in Alabama from a mode of living to one conducted for profit. And it is also destined to be a source of economic development.



FRIENDLY LIGHT

Familiar scene---the lamp of welcome at the door.

It is on 6,000 odd farms in Alabama the same well-extended quickly and easily at the touch of electric switch—with a flood of light both in and out.

Hours Mother spent on the old style lamps to the family now. Properly shaded electric lamps both young and old the best illumination can devise.

That electricity has eased many of the back.



What FACTORIES Mean to Farmers

Alabama's farmers, more than any other group, should be interested in the industrialization of the State.

Each family in Birmingham consumes an average of approximately \$800 of food products each year, according to statistics of the U. S. Department of Labor. Of these, foods to the value of \$450 are or could be produced in Alabama.

Out of every dollar of average family income in Huntsville, 40c is spent for food products, the Department of Labor estimates, or 30c for those grown in Alabama.

Thus the establishment of a new industrial plant, employing say 500 new workers and creating an annual payroll of about \$500,000, establishes a potential market for \$150,000 of rural products that are or could be grown by farmers of that vicinity.



Power Aids Diversification

THE cry for the farmer to "Diversify! Diversify!" has long been a popular clamor. Yet, whichever way the farmer turns to diversify, he is confronted with the problem of power.

Agricultural authorities agree that the diversification of crops depends for its success primarily upon the raising of products for which there is a substantial local market. The products most readily salable on local markets are poultry, truck, dairy products, hogs and beef cattle—all perishable, requiring refrigeration and the application of power for their most economical production.

Many cotton farmers in Alabama have solved their problems of diversification by shifting their burdens to the broad shoulders of power.

Whatever the secondary crop may be—dairying, poultry raising, truck growing or cattle raising—these cotton farmers are using power to aid their diversification programs. They are employing electricity to lighten the tasks of the farm housewife; for electric refrigeration, milking and feed grinding; for egg forcing, hatching and brooding, and for irrigation, insect control and plant germination in hot beds.

Thus, power is aiding Alabama's cotton farmers to produce other crops in a practical way and with profit. They are being enabled to take advantage of the new markets for food crops, being created in many cities and towns by the establishment of new industries.

ALABAMA POWER COMPANY
SERVING FARM—FACTORY—FIRESIDE



Power Development and the Farmer

THE ALABAMA FARMER is directly interested in the development and utilization of power, for power is the key to industrial development, and industrial development is of vital importance to agricultural prosperity.

An average of 3.41 horsepower of electricity is employed by each worker in America, according to the U. S. Census of Manufactures, 1925.

An industry in Alabama with 100 workers must have approximately 325 horsepower of electricity to turn its wheels.

Every time 3/4 horsepower of additional electric power is utilized by a new or existing enterprise in Alabama, a new created, paying wages with which to produce from the farmer, and other.

An average of 40c out of every family income in Huntsville, Alabama, is expended for food products, according to statistics of the U. S. Department of Agriculture. Thirty cents out of every dollar of food products that are or could be grown in Alabama.

Thus power development, through the creation of new payrolls, and new payrolls mean more for farm products.

It is therefore in the direct interest of the Alabama farmer that such a development of power as Alabama may have is put to industrialization.

ALABAMA POWER COMPANY
SERVING FARM—FACTORY—FIRESIDE



KILOWATT The New Farm Hand

Motor power is replacing and supplementing human power and animal power on over 1,000 general farms in Alabama, speeding production, relieving toil and reducing costs.

In no class of farming are more and varied uses made of electricity than in general farming operations. Small, but tireless motors—men of all work—displace laborious human power and slow animal power, saving time and money.

A PORTABLE ALL-PURPOSE MOTOR—A mechanical chore-boy—grinds feed, saws wood, threshes small grains, peas and beans, operates a hay hoist, and performs numberless other tasks quickly and cheaply.

IN THE FARM SHOP a small motor operates a grind stone, drill press and other machine tools for the repair of farm machinery, saving time and money.

ELECTRIC REFRIGERATION facilitates and encourages the curing of meats on farms—about 50 per cent of the meat killed on farms today being lost from spoilage by sudden changes in weather.

In performing chores—where electric light saves an average of an hour a day per man; in pumping water—where a power pump delivers for one cent more water—where numerous electric appliances assume the back-breaking labor that used to make farmers' wives old before their time; and in many other ways, Kilowatt is the new servant of all work, the new chore-boy, the new hand on Alabama's general farms.

ALABAMA POWER COMPANY
SERVING FARM—FACTORY—FIRESIDE

FIG. 7—THE COMPANY USES NEWSPAPER ADVERTISING TO ACQUAINT FARMERS WITH THE POSSIBILITIES OF ELECTRICITY IN AGRICULTURE, AND ALSO TO EMPHASIZE THAT INDUSTRIAL DEVELOPMENT IN THE STATE CREATES ADDITIONAL MARKETS FOR AGRICULTURAL PRODUCTS.

SERVICE CLASSIFICATION "E"

RURAL ELECTRIC SERVICE

110-220 VOLTS

AVAILABILITY

Available to any Consumer served from a rural distribution line of the Company for electric lighting, cooking, heating, refrigeration or farm power service, or any combination of these, where the total consumption can be measured by one meter.

RATE

5½ cents per KWH for the first 50 KWH consumed per month; plus
3½ cents per KWH for the next 950 KWH consumed per month; plus
2½ cents per KWH for all over 1,000 KWH consumed per month.

DISCOUNT

The current monthly bill is subject to a discount of ½ cent per KWH of energy consumed, provided the amount is paid in full at the office of the Company within ten days from date of bill.

RURAL LINE CHARGE

In addition to the rate for electric energy actually consumed each Consumer receiving service from a rural line shall pay monthly a Rural Line Charge based upon the number of Consumers per mile and the individual capacity contracted for, as follows:

Monthly Rural Line Charge:	Consumers per Mile			
	Over 15 Group "A"	Over 10 & not more than 15 Group "B"	Over 5 & not more than 10 Group "C"	5 or less Group "D"
For the 1st KW of contracted capacity or fraction thereof	\$1.75	\$2.25	\$3.00	\$4.00
For each additional KW of con- tracted capacity	1.50	1.50	1.50	1.50

DETERMINATION OF CONSUMERS PER MILE & CONSUMERS'
CONTRACTED CAPACITY

The Consumers per Mile shall be the total number of consumers served from the rural line, not including those in urban centers served from such line, divided by the total mileage of distribution pole line serving such Consumers, exclusive of service lines.

The Contracted Capacity of each Consumer shall be the sum total of his load requirements determined as hereinafter set out but not less than an amount sufficient to bring the total contracted capacity of all Consumers served by a rural line under this Classification to a minimum of 10 KW per mile of rural line. When urban or industrial load is served from a rural line the Company will credit the rural line with such

(Continued)

Effective for service rendered from rural lines authorized and constructed subsequent to July 1, 1927; for service rendered to any rural consumer requesting this classification on existing experimental rural lines; and for all rural service after June 30, 1930.

FIG. 8—SERVICE CLASSIFICATION "E," RURAL ELECTRIC SERVICE—PAGE 1, ALABAMA POWER COMPANY.

SERVICE CLASSIFICATION "E"

RURAL ELECTRIC SERVICE

110-220 VOLTS

(Continued)

business and will modify the minimum rural requirements according to Rule 9 under Special Rules Governing the Application of Service Classification "E".

Lighting Load:

Ordinary farm and household lighting load (including lamp socket appliances not permanently connected) will not be counted in determining contracted capacity, except where no other load is connected and in such case of lighting load only the contracted capacity shall not be less than 1 KW.

Motor Load:

a. GENERAL POWER—

The kilowatts of motor load other than seasonal power shall be as follows:
70% of the horsepower rating of the largest capacity motor; plus
50% of the horsepower rating of all other motors.

b. SEASONAL POWER—

The largest capacity motor used exclusively for farm power service, if of 10 horsepower rating or over, shall be considered a seasonal load and the kilowatts of motor load shall be taken as 25 per cent of its horsepower rating, provided the transformer capacity required for its operation is furnished by the Consumer.

Range Load:

25% of the connected domestic range load, but not less than 2 kilowatts.

Heating and All Other Load:

100% of the Manufacturer's rating of such equipment, or by test.

Where double throw switches are used, the maximum sum total of the Consumer's loads, as determined above, which can be operated at one time, will determine the contracted capacity.

OPTIONAL DEPOSIT IN LIEU OF RURAL LINE CHARGE

Any Consumer receiving service from a rural line may, at his option and in lieu of the monthly Rural Line Charge, deposit with the Company an amount equal to \$150 for each \$1 of monthly Rural Line Charge as determined above. Such deposit will be returned to the Consumer in full without interest at the time of the termination of his contract and in no instance less than one year from the beginning of service.

(Continued)

Effective for service rendered from rural lines authorized and constructed subsequent to July 1, 1927; for service rendered to any rural consumer requesting this classification on existing experimental rural lines; and for all rural service after June 30, 1930.

SERVICE CLASSIFICATION "E"

RURAL ELECTRIC SERVICE

110-220 VOLTS

(Continued)

SPECIAL RULES GOVERNING THE APPLICATION OF SERVICE
CLASSIFICATION "E"

1. A Rural Line is defined to be:

A. Any electrical distribution line of 11,000 volts or less, not within the corporate limits of a municipality, which serves less than twenty Consumers per mile of pole line, and/or

B. Any electrical distribution line of 11,000 volts or less, within the corporate limits of a municipality, which serves less than twenty Consumers per mile of pole line, upon approval of the Alabama Public Service Commission.

2. Each rural line as originally constructed shall be considered a unit in applying the rural line charge, unless there is such a wide difference in Consumer-density between sections or branches of such line as to constitute marked discrimination against the higher density group, and in this event such sections or branches may be considered separate rural lines.

3. New Consumers added to a rural line will be served under the same rural line charge as existing Consumers on such line, unless such addition constitutes an extension which would reduce the average number of Consumers per mile of line, in which event the extension shall be considered a new rural line.

4. Any section of a rural line immediately adjacent to the source of supply of such line reaching a density of 20 Consumers per mile shall become an urban line and service shall be rendered to such section at such urban rates as may be applicable, provided the remainder of such rural line can be served without increase in rural line charge to the Consumers served therefrom.

5. The Rural Line Charge or equivalent optional Rural Line Deposit of each Consumer shall be subject to adjustment on January 1st of each year.

6. The Company will furnish and install, free of expense to the Consumer, service wires from its pole line to the first approved point of permanent support, or to the first pole of service on Consumer's premises. Special service lines required to be constructed on private property shall be constructed by the Company at cost and will be subject to a special agreement between the Company and the Consumer, or Consumers, to be served.

7. Where three phase service is available for farm power service, such service at the option of the Consumer may be established for motor loads of 5 h. p. and over and billed as to a separate Consumer under this rate.

8. Any industrial Consumer served from a rural line shall be billed at the rate on file with the Public Service Commission applicable to such service.

9. The credit to a rural line for urban or industrial business shall be figured as follows:

(Continued)

Effective for service rendered from rural lines authorized and constructed subsequent to July 1, 1927; for service rendered to any rural consumer requesting this classification on existing experimental rural lines; and for all rural service after June 30, 1930.

FIG. 10—SERVICE CLASSIFICATION "E," RURAL ELECTRIC SERVICE PAGE 3, ALABAMA POWER COMPANY.

SERVICE CLASSIFICATION "E"

RURAL ELECTRIC SERVICE

110-220 VOLTS

(Continued)

- a. *Equivalent Rural Consumers*: To be found by taking four times the estimated first year's revenue to be received from the urban or industrial load less the initial cost to connect such additional load and dividing the remainder by 200.
- b. *Contracted Capacity*: Each equivalent Rural Consumer as determined above shall be considered as having one (1) kilowatt of contracted capacity.

NOTE: Rule 9 is based on the Company being willing to spend four times the initial annual revenue to obtain urban or industrial business served from a rural line and upon an average revenue per rural Consumer of \$50.00 per year. Reduced to a formula Rule 9-a becomes:

Equivalent Rural Consumers equals

$$\frac{\text{Estimated First Year's Revenue}}{\$50} \text{ less } \frac{\text{Estimated Initial Cost to Connect}}{4 \text{ times } \$50}, \text{ or}$$

$$\frac{(4 \text{ times Estimated First Year's Revenue}) \text{ minus } (\text{Initial Cost to Connect})}{200}$$

MINIMUM

In consideration of the readiness of the Company to furnish such service, a monthly minimum charge equal to the Rural Line Charge will be made.

TERM OF CONTRACT

Service under this Classification shall be for a period of not less than:

- (1) Five years on rural lines having an average of not over five (5) Consumers per mile of line,
- (2) Three years on rural lines having an average of not less than five (5) and not over ten (10) Consumers per mile of line,
- (3) One year on rural lines having an average of more than ten (10) Consumers per mile of line,

and thereafter from year to year, unless terminated by thirty (30) days written notice.

Service under this Classification is subject to Rules and Regulations approved or prescribed by the Alabama Public Service Commission.

Effective for service rendered from rural lines authorized and constructed subsequent to July 1, 1927; for service rendered to any rural consumer requesting this classification on existing experimental rural lines; and for all rural service after June 30, 1930.

[illegible]

FIG. 12—APPLICATION FOR SERVICE FORM, ALABAMA POWER COMPANY.

Com—1933—B-8353

CUSTOMER DEPOSIT CARD

(To be returned to applicant upon receipt of deposit)

Alabama Power Company,

Birmingham, Alabama.

Gentlemen:

I have today made written application to you for electric service at my residence at _____, Alabama, on your Form 1173 Service Classification _____. I understand that your rules and regulations require the deposit of \$_____ to insure prompt payment of bills for such service. I beg to advise that I will make such deposit on demand after construction work has begun on the distribution system in _____ and before the service is connected to my premises.

Yours very truly,

FIG. 13—CUSTOMER DEPOSIT CARD, ALABAMA POWER COMPANY.

manufacturers in the development of equipment needed for local conditions.

(k) When a farmer requests information for special installations, the Rural Service Section furnishes all available information and refers the prospect to such manufacturing companies that have shown ability and willingness to insure proper installations.

(l) Through the Manager of the Rural and Towns Division, the Engineering and Operating Departments are informed as to the nature of rural load affecting the construction and operation of rural lines. A consistent effort is made to prevent the lagging of rural line construction too far behind the signing of customers.

(m) In cooperation with the company's Publicity Department, the Rural Service Section prepared a thirty-two page booklet entitled "Electricity Serves the Farm." Ten thousand copies of this booklet were published and distributed, mainly to farmers of the State.

(n) The Rural Service Section cooperates with the Publicity Department in the preparation of advertising and news items for newspapers and magazines. The company's slogan is "Serving Farm, Factory and Fireside."

(o) Copies of "Electricity on the Farm" are distributed regularly to a selected list of 300 farm customers.

(p) The Rural Service Section cooperates with other agricultural agencies of the State in problems pertaining to the use of electricity in agriculture. An annual report of the Progress of Rural Electrifica-

tion is made to the Director of Agricultural Extension Service. Information as to the development of rural electric service is furnished the Agricultural Editor of the Extension Service.

(q) Close cooperation is maintained with the National Committee on the Relation of Electricity to Agriculture and the Rural Electric Service Committee of the National Electric Light Association, in the effort to make available more general and specific information as to rural electrification.

(r) The Rural Service Section keeps records of individual customers, rural lines and different equipment, necessary to keep an accurate check of the development's progress. A monthly report is made to the management, including the number of customers, number of lines and miles of lines added during the month, the total on the first of each month, the projects authorized and under construction and those under consideration.

A detailed annual report is made to the management, including customers, miles of lines and annual kilowatt-hour sales, with the progress made during the year in the different parts of the activity, as load building and increased energy consumption per rural customer, and per mile of rural line.

Selling Equipment to Rural Customers

Equipment handled by the company is sold to rural customers by representatives of the Merchandise Division. In case a rural customer desires equipment not sold by the company, arrangements are made to have his needs taken care of either by a local dealer or by the manufacturing company.

The company handles the usual line of electrical equipment, including ranges, water heaters, household refrigerators, washing machines and small appliances for the home. In addition, the company sells a line of water pumps especially for small town and rural customers.

Other equipment demanded by farmers, including dairy refrigerators, feed grinders, overhead irrigation systems, milking machines, incubators, brooders and motors, is sold by local dealers or factory representatives. The general sales plan is through the "live prospect" approach. These prospects are turned in by the rural service men. Prospects are found by the rural service men at the time of signing customers, or by the customers writing to the Rural Service Section for information pertaining to the use of some piece of equipment.

For equipment sold by the company the same term payments are offered to rural customers as to other classes of customers. These terms vary with different pieces of equipment.

The most important items sold to rural customers from a satisfactory load building standpoint are ranges, dairy refrigerators, household refrigerators and water systems. It is probable that farm refrigeration in its different ramifications will become the base load for rural electrification in this State. Sales efforts are turning in this direction.

Meter Reading and Billing Rural Customers

Meter reading and billing rural customers is handled just as the other classes of customers served by the company. Meters are read each month by the regular meter readers, and bills are rendered monthly by the Accounting Department.

Developing Appreciation of Rural Electric Service

Within the Company

Realizing that the success of rural electric development is dependent upon making it a part of the company's general program, rather than purely the activity of a separate division, those directly connected with this work have continuously attempted to sell the other departments of the company as to the progress and results obtained. This effort is through direct contact with employees of the different departments and through the preparation of monthly and annual progress reports. However, with the method of procedure followed by this company practically every department has an active part in the development just as with other classes of service. The surveys for new proposed lines are made by the Towns Division, the engineering is handled by the Engineering Department, the lines are built by the construction company, household equipment is sold to rural customers by the Merchandise Division, the lines are operated and service maintained by the Operating and Service Departments, and the rural customer billing and collecting is taken care of by the Accounting Department. Therefore, each department is somewhat familiar with the progress of the development.

Among Rural People

Interest in rural electric service was created in Alabama through exhibits at state and county fairs for two seasons, illustrating some of the uses and advantages of electricity, and through the progress of the experimental work conducted by the company and the Agricultural Experiment Station for a period of three years. This interest in and the appreciation of the value of electric service is maintained and developed among rural customers through education work conducted through direct contact with proposed and existing customers, and through cooperation with other agricultural agencies of the State. For example: In 1927 the company, in cooperation with the Dairy Department of the Agricultural Extension Service and the International Harvester Company, held a series of meetings throughout the State at which dairy equipment was discussed and demonstrated. In 1928 a series of meetings were held throughout the State in cooperation with the Home Demonstration Agents, and the Edison Electric Appliance Co. At these meetings the uses of electrical household appliances for the farm home were discussed and demonstrated. The agricultural engineers of the company devote the major part of their time in an effort to educate proposed and existing rural customers as to profitable applications of electricity. In 1928, as a part of its load-building program, the company published a farm booklet, discussing and illustrating some of the uses of electricity on Alabama farms. These booklets have been distributed among the existing and proposed rural customers.

Results and Effects

Number of rural lines Jan. 1, 1924.....	14
Number of rural lines Jan. 1, 1929.....	256
Miles of rural lines, Jan. 1, 1924.....	39
Miles of rural lines, Jan. 1, 1929.....	836.5
Number of rural customers Jan. 1, 1924.....	240
Number of rural customers Jan. 1, 1929.....	5,511

ANNUAL KW-HR. CONSUMPTION PER RURAL CUSTOMER

Lines Built	Dec. 31, 1927	Dec. 31, 1928
1928	...	670
1927	...	728
1926	445	512
1925	629	671
1924 (or earlier).....	900	1260
Total.....	708	834

The 256 lines are not only serving the present rural customers, but are also sources of electric service for additional extensions in the future development.

The company has an organization for conducting rural electric service work, actively engaged in an effort to build additional rural lines and to increase the load on existing rural lines.

The company had designed a rate for rural electric service, which has established rural electrification as a definite part of the company's development on a business basis.

The farmer's interest in the uses of electric service has been created and developed very rapidly.

The farmers of the State understand that the power company is perfectly willing and anxious to

attempt in every way economically possible to extend service to them. They also appreciate the fact that if rural electric service is to be successful it must be satisfactory to the customers and the company.

The company realizes that it is possible to develop a satisfactory rural load.

The average energy consumption by rural customers has increased from 383 kw-hr. in 1924 to 834 kw-hr. in 1928.

Rural electric service is:

1. Resulting in more comfortable and attractive living conditions on the farm.
2. Creating new interest in farming as a life occupation.
3. Reducing farm operating costs and making practical a better balanced farming program.
4. Making available a source of convenient power for the operation of rural community enterprises.
5. Establishing a better mutual understanding between the farmers and the company.

RURAL LINES AND SYSTEMS

I. Types of Systems

- (a) 2300 and 4000-volt systems.
- (b) 6900-volt systems.
- (c) 11,500-volt systems.

The 2300 and 4000-volt systems are merely short extensions of existing urban distribution systems which are extended into rural territory. The 6900-volt, 3 ϕ lines were first constructed when it developed that the 2300 and 4000-volt lines did not have capacity to supply the loads as found in the rural territory in Alabama. The majority of these lines have been reconnected as four-wire systems for 11,000-volt operation. Practically all of the rural lines now being constructed by the company are 11,000-volt systems.

These lines are supplied either from step-up banks located at the end of an urban feeder or from separate rural distribution substations. These are usually 44,000 to 6900-volt Y substations, equipped with automatic reclosing circuit breaker and ground relay protection which opens the circuit in case the conductor falls to the ground.

II. Line Construction

Lines are constructed according to the following general specifications:

(a) Right of way:

Lines are constructed along the margin of the public road, permission being obtained from state or county authorities. Tree trimming and anchor rights are obtained from individual property owners.

(b) Poles:

35 ft. 6 in. top creosoted pine.

(c) Cross arms:

Standard N. E. L. A. 6-pin arms with standard braces and hardware.

(d) Conductors:

Conductors are either hard-drawn copper or aluminum cable steel reinforced.

(e) Pins:

Standard wood pins are used on straight line construction. A clamp-on steel pin for small angles and dead end with strain insulators on angles 30 deg. and over.

(f) Insulators:

Insulators are standard 17 kv. porcelain pin type.

NOTE: Even though lines are built to operate at 2300 or 6900 volts, they usually are insulated for 11,000-volt operation, in view of changing over to this voltage as load conditions may require.

(g) Pole Spacing:

Pole spacing is approximately 275 ft. with copper conductors, and 325 to 350 ft. with aluminum. Highway conditions often make it impossible to obtain a 325-ft. span, in which case the company has found it more economical to use copper conductors.

(h) Anchoring:

Angles of 7 deg. and less usually are held by raking the pole without anchoring. Angles of over 7 deg. are supported with one or two patented anchors as required.

Pole setting and wire stringing is done in accordance with the National Electric Safety Code.

III. Secondary Service

Secondary service usually is furnished at 110-220 1 ϕ or 220 3 ϕ . Transformers are standard distribution transformers protected with open type of fuses and standard lightning arresters.

On the majority of systems of the Alabama Power Company it is found economical to string secondary systems and connect several customers from the same transformer bank.

N. E. L. A. INFORMATIONAL LITERATURE

- 289-14 **The Electric Light and Power Industry in the United States.** Paper binding, 1 to 25 copies, \$1.00 each; 26 to 100 copies, 90c. each; 101 to 500 copies, 85c. each; 501 or more, 75c. each.
- 289-3 **N. E. L. A. Handbook.** Compiled by Public Speaking Committee. \$2.50 per copy.
- 289-13 **Government (Political) Ownership and Operation and the Electric Light and Power Industry.** 1 to 10, \$1.50 per copy; 11 to 25, \$1.40 per copy; 26 to 100, \$1.30 per copy; 101 or more, \$1.25 per copy.
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- 278-94 **The National Electric Light Association During the Administrative Year 1927-1928.** By H. T. Sands. \$4.00 per 100.
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- Rural Electric Service Committee**
1928-1929
- 289-65 **Developing Electric Service for the Farm.** 40c. each; to members 25c.
- 289-77 **Serial Report.**
- Customer Ownership Committee**
1928-1929
- 289-78 **Serial Report.**

NATIONAL ELECTRIC LIGHT ASSOCIATION

420 Lexington Avenue

New York City

S u m m a r y ▼

This report shows the progress in Rural and Farm Electrification in the United States from 1921 to the end of 1931.

The number of farm customers has grown from 177,561 at the beginning of 1924 to 698,786 at the end of 1931, an increase of 521,225 or 293 per cent, averaging 65,150 or 36 per cent yearly for the 8 year period.

According to report of the Bureau of the Census, 845,356 farms or 13.5 per cent of the total number of farms in the United States had electric service as of April, 1930. Of this number, 249,342 or 4 per cent had individual plants and 596,014 or 9.5 per cent were being served by electric light and power companies. At the mid-year 1932, there were approximately 1,000,000 farms with electric service from power companies and individual plants, and 1,000,000 other rural customers outside of incorporated cities and villages. Based on the Bureau of the Census definition of rural territory, which includes all areas outside of towns of over 2,500 population, the total number of customers served in rural territory was approximately 4,000,000.

—N. E. L. A. Publication No. 237.
August, 1932. Prices: 25c to members;
40c to non-members. Quantity discounts
upon request.

PROGRESS IN ▼ ▼ **RURAL AND FARM** **ELECTRIFICATION**

For the 10 Year Period
1921-1931

Report of the ▼ ▼

Rural Electric Service Committee,
A General National Committee

National Electric Light Association

FOUR-TWENTY LEXINGTON AVENUE, NEW YORK, N. Y., U. S. A.

CONTENTS

	PAGE
Early Rural Service Development.....	1
Interconnected Network a Foundation.....	1
More Than 700,000 Farms Served.....	1
Electrification Follows Interconnection.....	1
General Statistics.....	5
Committee on the Relation of Electricity to Agriculture Or- ganized.....	5
State Committees.....	11
Bibliography of Publications.....	13
Farm Equipment Committee Organized.....	13
Employment of Especially Qualified Rural Service Men.....	13
Service Also to Small Hamlets.....	13
Rural Line Costs.....	13
A Mutual Problem.....	13
Rural Electric Service Committee Personnel.....	14

INDEX TO TABLES, CHARTS AND MAPS

(Data for the most part are by states)

Acreage in Farms—Map showing geographic distribution.....	6
Automobile—Number of farms having.....	9
Customers—All electric light and power customers.....	11
Electrified Farms—	
Map showing distribution of electrified farms.....	3
Number of farms served by light and power enterprises (1924–1932)....	4
Number of farms connected by years (chart).....	5
Number of farms having individual lighting installation.....	8
Number of all farms electrified.....	8
Electric Motors (for farm work)—Number of farms having.....	9
Families—Total number of urban, farm and non-farm families..	12
Farms—Total number of all farms on April 1, 1930.....	5
Geographic distribution of all farms (map).....	6
Generating Capacity—Kilowatts of capacity of all electric light and power enterprises.....	11
Kilowatthours consumed on farms (years 1930 and 1931).....	7
Kilowatthour consumption per farm customer.....	7
Kilowatthours generated by all electric light and power enter- prises.....	11
Motor Trucks—Number of farms having.....	9
Population—Urban, farm and non-farm population.....	12
Roads—Kind of road passing farm dwelling.....	10
Stationary Engines—Number of farms having.....	9
Telephones—Number of farms having.....	8
Tractors—Number of farms having.....	9
Transmission Lines—Map of transmission lines 30,000 volts and above.....	2
Water Piped Dwellings—Farms having running water in farm houses.....	8
Farms having running water in bathroom.....	8
Wired Homes—Number of urban, farm and non-farm wired homes.....	12

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Progress in Rural and Farm Electrification

For the 10 Year Period 1921-1931¹

Early Rural Service Development

About 10 years ago leaders of the electric light and power industry began to sense the importance of constructive attention to the problem of developing electric service for American agriculture. At that time there were perhaps 100,000 farms on which electric service was available and used chiefly for water pumping in irrigated farming sections. The idea that electricity would become a source of energy for farm operations and serve as the basis for the greatest improvement in the farm home experienced in over 50 years was held by very few men. In the past, attempts had been made to stir up interest in this field, but without material success. The location of the first farm in the United States to use electric service is not generally known. However, the general practice of furnishing electric service to agriculture first flourished in the irrigated regions of the far West. The highest state of development for this practice was probably attained in California.

Interconnected Network a Foundation

In looking back it is not difficult to see that rural electrification as a great national movement was to wait upon the establishing of generating and distributing facilities which insured 24 hr service for practically every town and city of 1,000 or more population. It was necessary to build the electrical foundation for generation and primary distribution of electricity before the great network of rural lines could start its spread over our farming regions. Today this electrical foundation is available and one of the most important steps looking to the general use of electricity on our farms has been taken. This foundation of the interconnected primary distribution systems of the United States is illustrated in Fig. 1.

While this development has been in progress, the industry has been far from idle in other directions having important bearing on the efficient use of electricity on the farm. To organize these activities, the National

Electric Light Association in 1921 set up this committee, first, under the name of the Rural Lines Committee, and later changed the name to the Rural Electric Service Committee.

This committee was directed to study, investigate and make recommendations for the solution of the problems involved in rendering electric service to the farmer. The first reports of the committee review the existing situation, direct attention to the growing and urgent demands for the service in all parts of the country and the need for comprehensive consideration. They discuss some of the fundamentals and economics involved, describe the magnitude of the market for the service, and recommend, among other things, cooperation with agricultural organizations in the mutual interest.

In carrying out the program outlined in the scope of its activities, and to make available such information as there was, the committee undertook, as one of its first steps, the compilation of statistical data relating to the subject, and to devise a means for gaging progress. It was believed that one of the most effective measures for such purpose was the number of farms being served by power companies, and an attempt was made to obtain such information. A survey was made and it was reported that on December 31, 1923, there were 166,159 farms being served by electric light and power companies. At a later date this figure was revised to 177,561. When the Statistical Department of the Association was organized in 1927, it assumed responsibility for the gathering of these statistics. In addition to this, the Federal Bureau of the Census reported the number of farms having electric service as of April, 1930.

More Than 700,000 Farms Served

A summary of these available statistics is given in Table I which shows that at the end of 1931 there were 698,786 farms served, as compared to 177,561 at the end of 1923. This is an increase of 521,225 farms or 293 per cent, averaging 65,150 or 36 per cent yearly for the 8 year period. On April 30, 1932, there were 702,963 farms served.

This increase in number of farms connected is portrayed graphically in Fig 3.

Table II shows comparatively the number and percentage of farms served by states for the years ending 1923 and 1931.

The 10 states having the largest number of farms served at the end of the year 1931 are:

California.....	86,548
New York.....	51,439
Ohio.....	45,730
Pennsylvania.....	41,467
Wisconsin.....	37,833
Washington.....	36,143
Michigan.....	34,230
Iowa.....	31,688
Illinois.....	26,994
Indiana.....	22,106

There are 6 states in which over 50 per cent of the farms have this service:

	%
California.....	63.8
Rhode Island.....	59.5
Utah.....	56.8
Massachusetts.....	55.8
Connecticut.....	53.0
Washington.....	51.0

and 9 states where the percentage is between 25 and 50:

	%
New Jersey.....	47.3
New Hampshire.....	43.8
Maine.....	33.0
New York.....	32.1
Vermont.....	30.0
Idaho.....	29.8
Oregon.....	29.7
Arizona.....	29.0
Nevada.....	27.4

and 5 more states where the percentage is between 15 and 25:

	%
Pennsylvania.....	24.0
Ohio.....	20.9
Wisconsin.....	20.8
Michigan.....	20.2
Indiana.....	16.1

Electrification Follows Interconnection

On the basis of figures supplied by the Bureau of the Census, a map, Fig. 2, was prepared, showing the geographic location of farms served by electric light and power companies. Another map, Fig. 4, shows the density of farms in the United States.

Table III shows the number of farms served, kilowatthours sold and consumption per farm for 1931 compared with 1930. This shows an increase of 9.3 per cent in customers in the eastern area and 15.8 per cent increase in kilowatt hours consumed,

Publication No. 237, Report, Rural Electric Service Committee.

¹ With acknowledgments to the Statistical Department of the N.E.L.A. for the collection and presentation of the statistics.

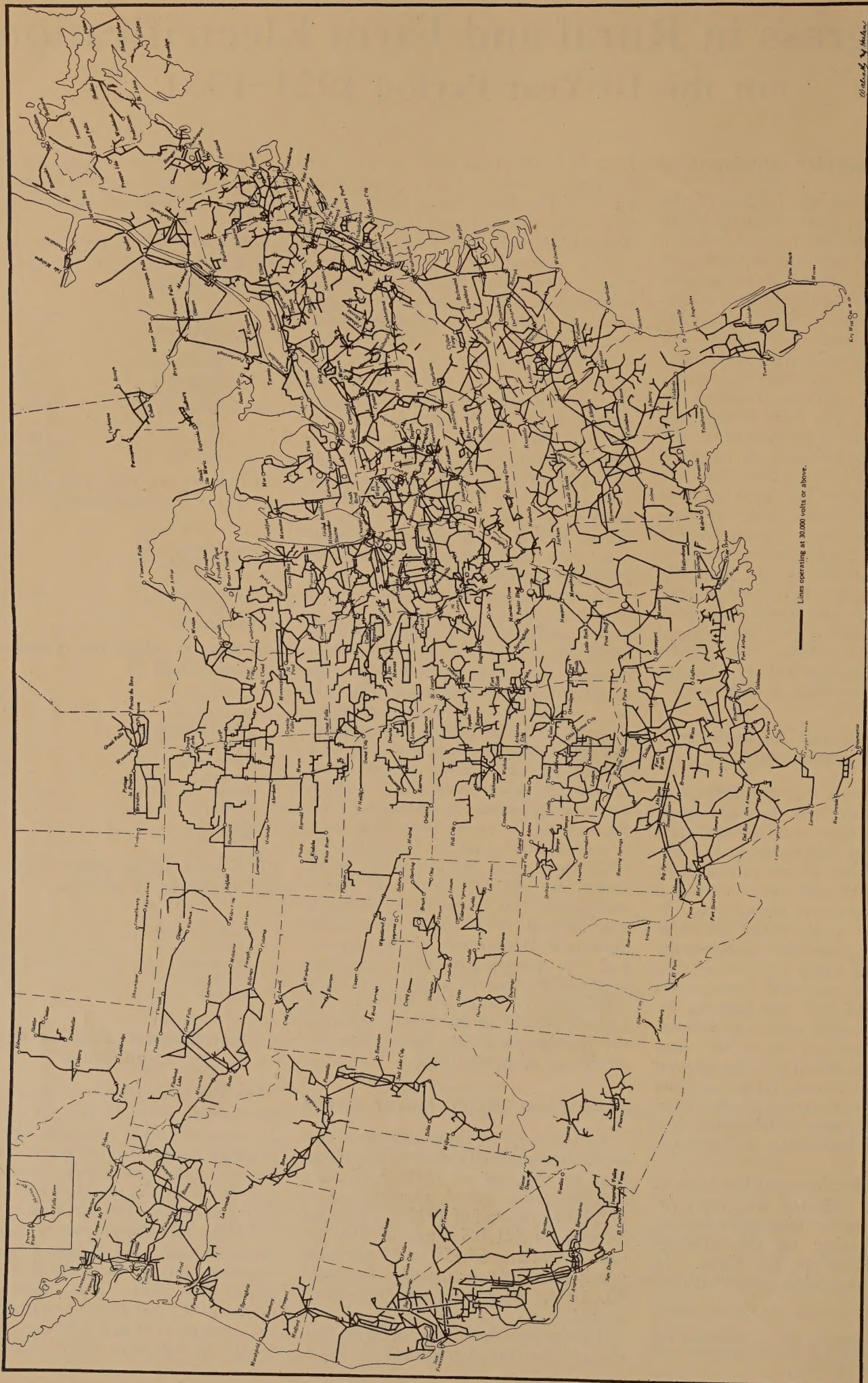


Fig. 1—High Tension Interconnected Electric Systems of the United States and Canada
(Source of Data—The Annalist—New York Times Publishing Co.)

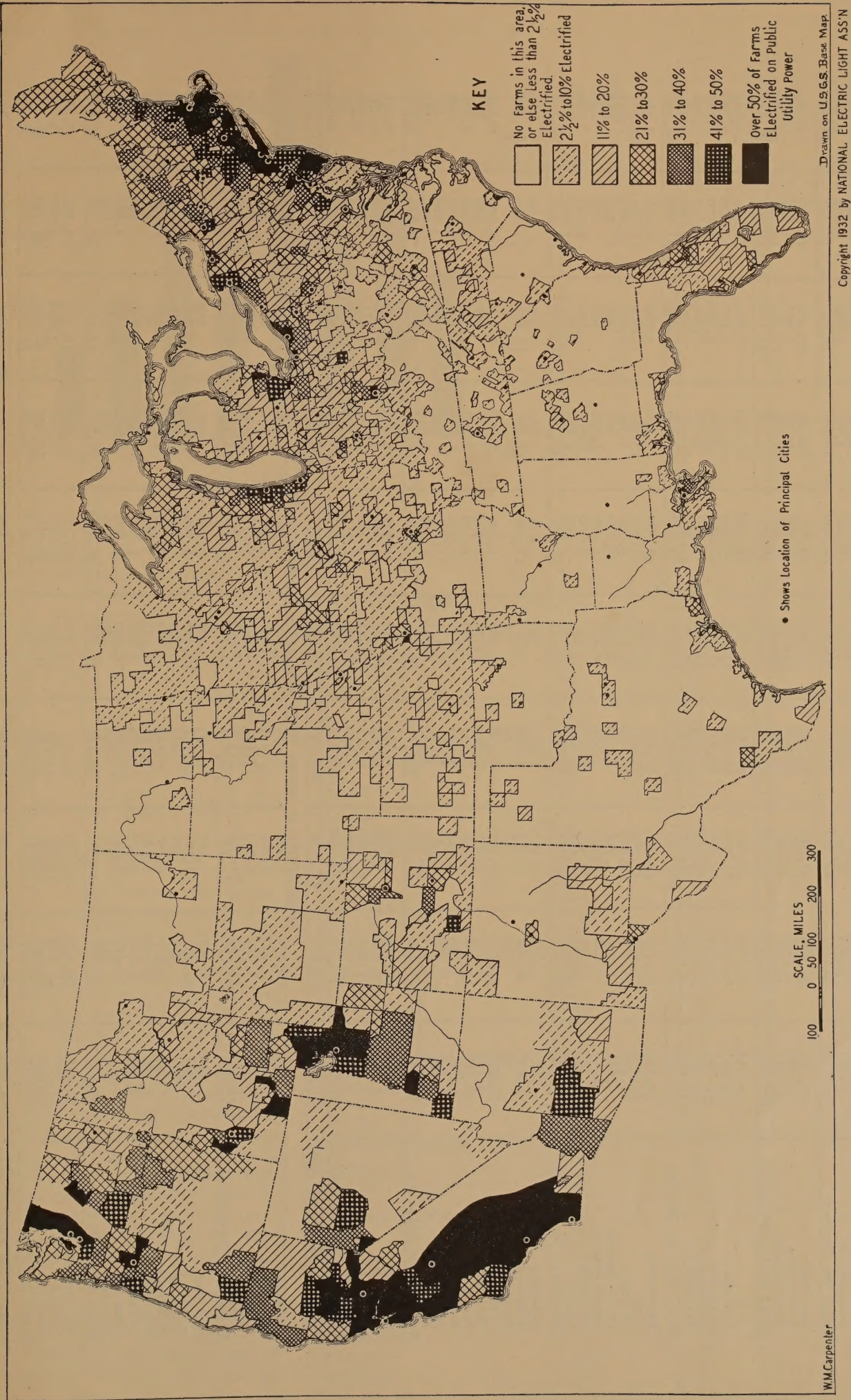
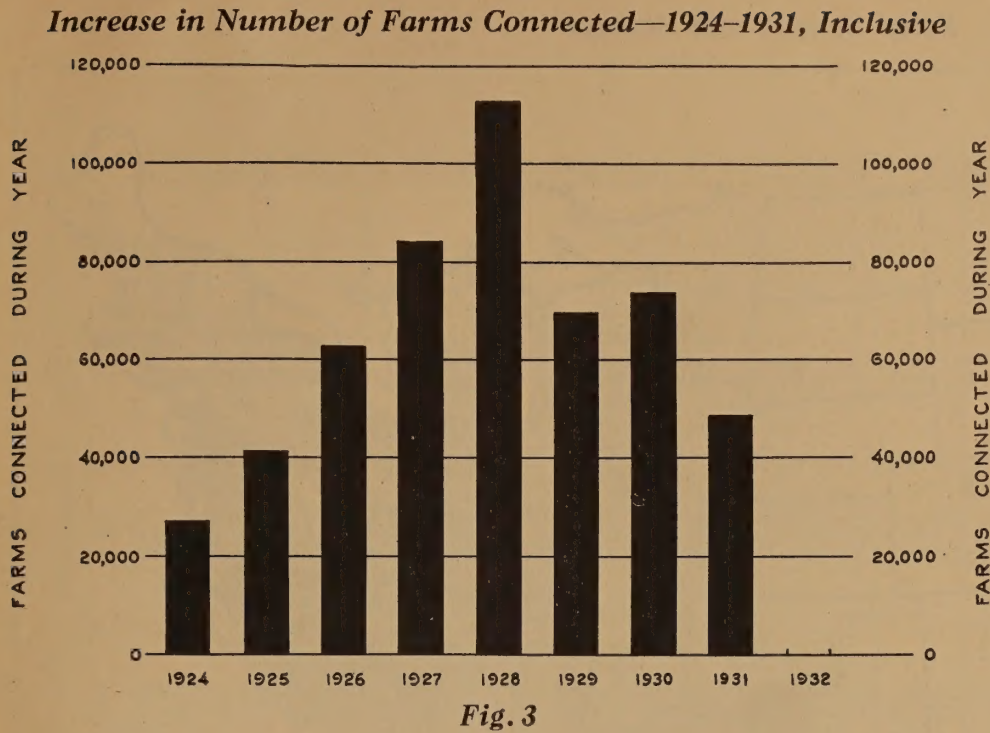


Fig. 2—Distribution of the Electrified Farms of the United States—January 1, 1930
(Source of Data—N.E.L.A. Statistical Department Based on 1930 U. S. Census of Agriculture)

TABLE I—NUMBER OF FARMS SERVED—DATA DO NOT INCLUDE INDIVIDUAL LIGHTING INSTALLATIONS

	On December 31st									
	April 30th 1932	1931	1930	1929*	1928	1927	1926	1925	1924	1923
Total United States	702,963	698,786	649,919	576,168	506,242	393,221	309,125	246,150	204,780	177,561
FARMS SERVED IN STATES WHERE LITTLE OR NO IRRIGATION IS INVOLVED										
Maine	12,848	12,888	12,001	10,938	9,162	8,000	7,200	6,500	6,000	5,676
New Hampshire	6,704	6,528	5,658	5,014	2,718	2,600	2,500	2,400	2,400	2,396
Vermont	7,656	7,461	6,986	6,403	6,000	5,000	4,000	3,100	2,700	2,384
Massachusetts	14,288	14,289	14,088	13,821	13,310	11,000	9,000	6,000	4,000	2,440
Rhode Island	1,978	1,974	1,811	1,667	1,500	1,500	1,500	900	600	400
Connecticut	9,089	9,097	8,452	7,675	7,530	6,000	4,500	3,000	3,000	2,626
Total New England	52,543	52,237	48,996	45,522	40,367	34,100	28,500	22,400	18,700	15,922
New York	51,689	51,439	47,147	43,350	37,431	33,300	30,500	25,400	20,000	16,000
New Jersey	12,250	12,005	11,212	10,968	10,071	8,400	7,500	6,500	5,000	4,000
Pennsylvania	41,271	40,457	37,983	33,215	28,468	24,200	19,369	16,200	14,100	12,918
Total Middle Atlantic	105,210	104,911	96,342	87,533	75,970	63,900	53,919	44,100	35,700	29,918
Ohio	46,234	45,730	43,242	37,695	31,724	27,200	22,800	19,800	18,300	16,803
Indiana	22,215	22,106	20,503	18,569	16,639	15,100	14,100	13,000	12,000	11,237
Illinois	27,419	26,994	22,899	18,317	15,200	10,400	7,260	4,600	3,200	2,201
Michigan	38,373	34,230	29,869	24,233	18,900	11,600	6,800	5,200	3,700	2,996
Wisconsin	38,217	37,183	34,800	30,233	23,871	11,200	11,000	9,300	8,200	7,429
Total East No Central	169,458	166,893	151,113	129,047	106,334	74,900	52,960	43,000	37,000	32,657
Minnesota	14,182	14,206	13,121	12,413	11,371	9,200	6,600	4,900	4,100	3,339
Iowa	31,655	31,688	29,634	25,149	21,825	17,000	13,500	12,400	11,700	11,237
Missouri	16,229	16,416	14,418	12,486	10,895	5,600	3,766	3,200	3,000	2,913
North Dakota	1,881	1,834	1,711	1,721	1,600	1,700	1,400	400	200	114
South Dakota	3,015	3,040	2,846	2,534	2,416	1,700	1,200	800	600	483
Nebraska	9,813	9,930	8,960	7,960	6,400	4,000	2,500	1,600	1,000	900
Kansas	13,105	12,603	11,593	10,305	8,805	6,400	3,500	2,300	1,400	900
Total West No Central	89,880	89,717	82,283	72,093	63,872	46,000	31,866	25,600	22,800	19,776
Delaware	1,083	1,296	1,163	1,027	800	771	700	400	160	105
Maryland	6,425	6,961	6,614	6,226	5,389	4,000	2,700	1,800	1,300	1,000
Dist of Columbia	69	70	66	54	54	4,100	3,300	2,700	2,300	2,100
Virginia	11,875	11,972	10,105	7,730	5,065	1,500	900	500	300	215
West Virginia	3,387	3,307	2,891	2,844	2,392	1,500	1,000	500	200	210
North Carolina	10,013	10,082	9,450	8,774	7,700	4,500	2,467	2,300	2,200	2,100
South Carolina	3,741	3,746	3,493	3,039	2,640	1,900	1,250	1,100	1,000	900
Georgia	5,048	5,309	4,372	3,591	3,473	1,700	510	300	200	137
Florida	5,196	5,214	4,385	4,131	3,794	2,200	1,015	700	500	353
Total South Atlantic	46,837	47,958	42,339	37,416	31,507	20,671	12,842	9,800	7,960	6,910
Kentucky	8,231	7,716	6,815	5,863	5,340	4,700	4,200	3,800	3,600	3,411
Tennessee	8,086	7,996	7,585	6,720	6,464	4,800	3,225	2,400	1,800	1,350
Alabama	12,371	12,326	12,001	9,000	7,726	4,300	2,000	1,500	1,200	1,000
Mississippi	3,232	3,475	3,548	2,354	2,200	1,500	1,000	700	600	500
Total East No Central	31,920	31,513	29,549	23,937	21,730	15,300	10,425	8,400	7,200	6,261
Total above Eastern Area	495,848	493,229	451,222	395,548	339,500	254,871	190,512	153,300	128,560	111,444
FARMS SERVED IN STATES WHERE IRRIGATION MAY BE INVOLVED										
Arkansas	3,074	3,253	3,202	2,689	2,581	1,700	1,100	800	600	500
Louisiana	2,703	2,447	2,218	1,949	1,557	1,200	900	600	400	275
Oklahoma	5,363	4,927	4,517	3,942	3,607	2,800	2,300	1,900	1,700	1,600
Texas	11,215	11,543	11,501	9,954	9,622	7,300	6,100	3,600	2,800	2,100
Total West So Central	22,355	22,170	21,438	18,534	17,367	13,000	10,400	6,900	5,500	4,475
Montana	2,395	2,377	2,192	1,983	1,869	1,200	700	650	600	550
Idaho	12,568	12,402	12,126	10,731	10,430	8,300	6,900	5,800	5,200	5,050
Wyoming	534	523	476	454	377	350	325	300	290	280
Colorado	7,126	7,170	6,757	6,548	5,594	3,200	1,800	1,400	1,200	1,118
New Mexico	1,340	1,340	1,242	1,102	1,034	600	375	300	280	250
Arizona	4,540	4,110	3,805	3,070	2,846	1,500	863	450	300	25
Utah	15,419	15,443	15,062	14,462	14,400	10,600	8,050	5,800	4,300	3,330
Nevada	959	943	876	810	800	600	400	250	150	125
Total Mountain	44,881	44,308	42,536	39,160	37,350	26,350	19,213	14,950	12,320	10,928
Washington	36,815	36,143	33,803	29,070	27,500	23,000	19,000	16,000	14,400	13,400
Oregon	16,839	16,388	15,767	14,991	12,800	10,000	8,000	7,000	6,000	5,350
California	86,225	85,548	85,153	78,865	71,625	66,000	62,000	48,000	38,000	32,064
Total Pacific	139,879	139,079	134,723	122,926	111,925	99,000	89,000	71,000	58,400	50,714
Total above Western Area	207,115	205,557	198,697	180,620	166,642	138,350	118,613	92,850	76,220	66,117

(Source of Data—U. S. Census of Agriculture for 1929, All Other Years N.E.L.A. Statistical Department)



while the western area shows an increase of 3.3 per cent in customers and 2.7 per cent in consumption.

Table IV shows interesting data on number of telephones, water piped dwellings and electrically lighted farm homes. Of the latter there were 596,014 or 9.5 per cent with service from power lines, and 249,342 or 4 per cent with farm plants, making the total 845,356 farms having these forms of electric service, which is 13.5 per cent of the total number of farms in the United States as of April, 1930.

General Statistics

Table V shows other interesting statistical information on mechanical equipment on farms, showing the number of farms having tractors and motor trucks is about the same as the total number of electrically lighted homes, and that there are still 945,000 stationary engines on farms, a large percentage of which, undoubtedly, could be replaced by electric motors.

Table VI shows the type of roads passing farmers' dwellings, showing the number of farms located on hard surfaced roads throughout the country is about the same as the number with electric service from power companies.

Table VII shows by states the total number of customers, capacity of generating facilities, and total number of kilowatthours generated for the year ending 1931.

Table VIII shows the total population of the United States, the total number of families, and the number of homes having electric service, all classified to show urban and rural

population, the number of urban and rural farm and non-farm families and homes having electric service. The number of families in rural territory, not yet served, gives an indication of the possibilities for future development of rural electrification.

Committee on the Relation of Electricity to Agriculture Organized

Early in this development it was recognized that while farmers wanted electric service and officials of power companies desired to render the service, the results then being obtained were not satisfactory. The cost of delivering the small amount of electricity required for the farm home was excessive. The farmer thought he could not afford to pay even the amount necessary to cover these delivery costs, and the power companies could not afford to extend lines, and render ser-

TABLE II—NUMBER AND PERCENTAGE OF FARMS SERVED—1923 AND 1931
Number of Farms Served

	No of Farms April 1930	December 31, 1923		December 31, 1931	
		Number	%	Number	%
Total United States	6,288,648	177,561	2.8	698,786	11.1
Maine	39,006	5,676	11.3	12,888	33.0
New Hampshire	14,906	2,396	11.4	6,528	43.8
Vermont	24,898	2,384	8.6	7,461	30.0
Massachusetts	25,598	2,440	7.3	14,289	55.8
Rhode Island	3,322	400	10.2	1,974	59.5
Connecticut	17,195	2,626	11.3	9,097	53.0
Total New England	124,925	15,922	10.1	52,237	41.9
New York	159,806	16,000	8.5	51,439	32.1
New Jersey	25,378	1,000	3.4	12,005	47.3
Pennsylvania	172,419	12,918	6.5	41,467	24.0
Total Middle Atlantic	357,603	29,918	7.1	104,911	29.4
Ohio	219,296	16,803	6.6	45,730	20.9
Indiana	181,570	3,228	1.6	22,106	12.2
Illinois	214,497	2,201	1.0	26,994	12.6
Michigan	169,372	2,996	1.6	34,230	20.2
Wisconsin	181,767	7,429	3.9	37,833	20.8
Total East No Central	966,502	32,657	3.1	166,893	17.3
Minnesota	185,255	3,339	1.8	14,206	7.7
Iowa	214,928	11,237	5.3	31,688	14.7
Missouri	255,940	2,913	1.1	16,416	6.4
North Dakota	77,975	114	0.2	1,634	2.4
South Dakota	83,157	483	0.6	3,040	3.7
Nebraska	129,458	790	0.6	9,330	7.7
Kansas	166,042	900	0.5	12,603	7.6
Total West No Central	1,112,755	19,776	1.8	89,717	8.0
Delaware	9,707	105	1.0	1,296	13.4
Maryland & D. C.	43,307	1,000	2.0	7,031	16.1
Virginia	170,610	2,100	1.1	11,972	7.1
West Virginia	82,641	215	0.2	3,307	4.0
North Carolina	279,708	2,100	0.7	10,083	3.6
South Carolina	157,931	900	0.5	3,746	2.4
Georgia	255,598	137	0.1	5,309	2.1
Florida	58,966	353	0.6	5,214	8.8
Total South Atlantic	1,058,468	6,910	0.6	47,958	4.5
Kentucky	246,499	3,411	1.3	7,716	3.1
Tennessee	245,657	1,350	0.5	7,996	3.3
Alabama	257,395	1,000	0.4	12,326	4.8
Mississippi	312,663	500	0.2	3,475	1.1
Total East So Central	1,062,214	6,261	0.6	31,513	3.0
Arkansas	242,334	500	0.2	3,253	1.3
Louisiana	161,445	275	0.2	2,447	1.5
Oklahoma	203,866	1,600	0.8	4,927	2.4
Texas	495,489	2,100	0.5	11,543	2.3
Total West So Central	1,103,134	4,475	0.4	22,170	2.0
Montana	47,495	550	1.2	2,377	5.0
Idaho	41,674	5,050	12.5	12,402	29.8
Wyoming	16,011	280	1.8	523	3.3
Colorado	59,956	1,118	1.9	7,170	11.9
New Mexico	31,404	250	0.8	1,340	4.3
Arizona	14,173	225	2.1	4,110	29.0
Utah	27,159	3,330	12.9	15,443	56.8
Nevada	3,442	125	3.2	943	27.4
Total Mountain	241,314	10,928	4.6	44,308	18.4
Washington	70,904	13,400	18.3	36,143	51.0
Oregon	55,153	5,250	9.4	16,388	29.7
California	135,676	32,064	23.5	86,548	63.8
Total Pacific	261,733	50,714	20.3	139,079	53.2

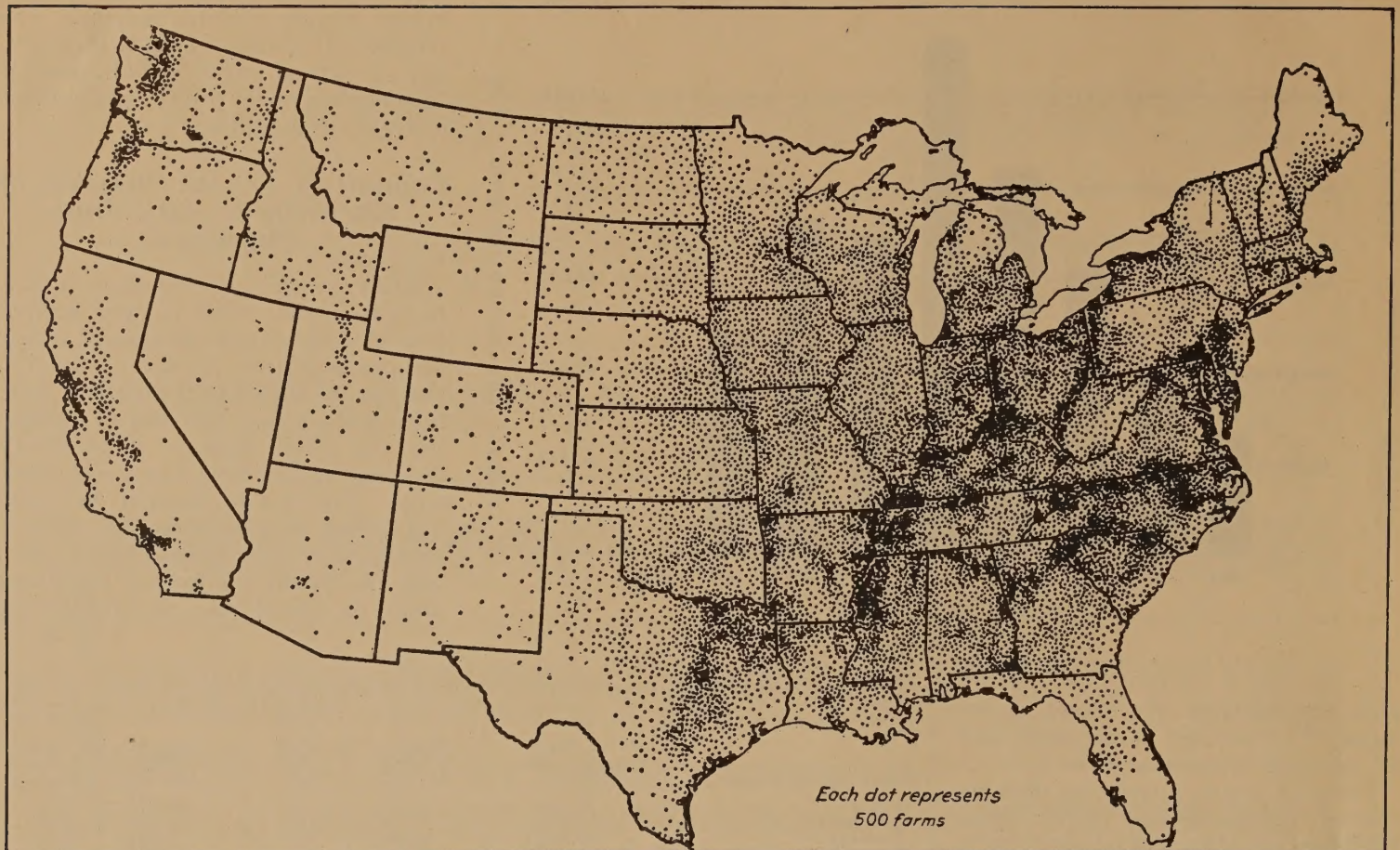
Farm Density and Acreage

Fig. 4—Number of Farms—United States Total 6,288,648

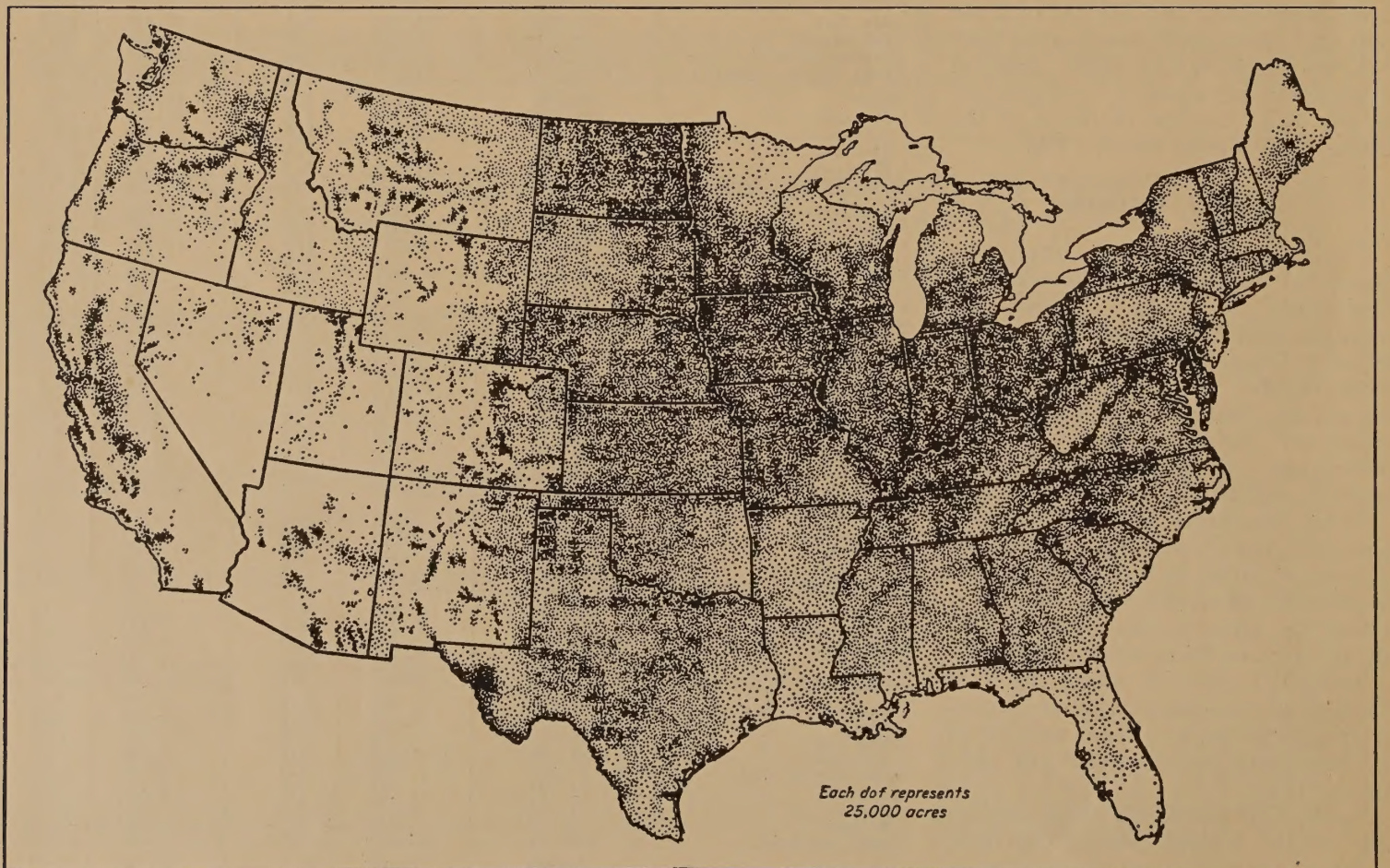


Fig. 4a—Total Land in Farms—United States Total 920,000,000 Acres
(Source of Data—U. S. Department of Agriculture Miscellaneous Publication No. 105—Mr. O. E. Baker)

TABLE III—NUMBER OF FARMS SERVED, KILOWATTHOURS SOLD AND CONSUMPTION PER FARM

State or Division	Farms Served		% Increase	Kilowatt-hours Sold		% Increase	Kw-hrs Per Customer	
	1931	1930		1931	1930		1931	1930
Total United States	698,786	649,919	+ 7.5	1,878,644,000	1,788,792,000	+ 5.0	(Not Applicable)	
FOR STATES IN WHICH LITTLE OR NO IRRIGATION IS INVOLVED								
Maine	12,888	12,001	+ 7.4	6,438,000	5,597,000	+15.0	516	488
New Hampshire	6,528	5,658	+15.4	3,726,000	2,935,000	+27.0	597	550
Vermont	7,461	6,986	+6.8	4,783,000	3,913,000	+22.2	651	586
Massachusetts	14,289	14,088	+1.4	15,755,000	14,122,000	+11.6	1,100	1,012
Rhode Island	1,974	1,811	+9.0	1,353,000	1,072,000	+26.2	715	616
Connecticut	9,097	8,452	+7.6	5,175,000	4,695,000	+10.2	598	586
Total New England	52,237	48,996	+ 6.6	37,230,000	32,335,000	+15.1	731	684
New York	51,439	47,147	+ 9.1	32,441,000	28,190,000	+15.1	719	623
New Jersey	12,005	11,212	+ 7.1	8,899,000	8,173,000	+ 8.9	773	737
Pennsylvania	41,467	37,983	+ 9.2	32,654,000	28,585,000	+14.2	822	803
Total Middle Atlantic	104,911	96,342	+ 8.9	73,994,000	64,949,000	+13.9	768	706
Ohio	45,730	43,242	+ 5.8	32,616,000	31,647,000	+ 3.1	724	782
Indiana	22,106	20,503	+ 7.8	13,170,000	13,431,000	- 1.9	623	617
Illinois	26,994	22,699	+13.9	20,609,000	15,237,000	+35.3	809	743
Michigan	34,230	29,869	+14.4	25,242,000	19,206,000	+31.4	772	710
Wisconsin	27,833	24,800	+ 8.7	32,447,000	28,973,000	+12.0	880	891
Total East No Central	166,893	151,113	+10.4	124,084,000	108,494,000	+14.4	770	774
Minnesota	14,206	13,121	+ 8.3	10,978,000	9,320,000	+17.8	772	730
Iowa	31,688	29,634	+ 6.9	21,396,000	18,822,000	+13.7	696	687
Missouri	16,416	14,418	+13.9	11,814,000	10,614,000	+11.3	756	789
North Dakota	1,834	1,711	+ 7.2	1,450,000	1,344,000	+ 7.9	759	783
South Dakota	3,040	2,846	+ 6.8	2,210,000	1,945,000	+13.6	737	723
Nebraska	9,930	8,960	+10.8	7,755,000	6,998,000	+10.8	814	841
Kansas	12,603	11,593	+ 8.7	11,553,000	10,840,000	+ 6.6	939	990
Total West No Central	89,717	82,283	+ 9.0	67,156,000	59,893,000	+12.1	770	776
Delaware	1,296	1,163	+11.4	1,238,000	726,000	+70.5	990	695
Maryland	6,961	6,614	+ 5.2	6,550,000	5,650,000	+15.5	954	880
Dist of Columbia	70	66	+ 6.1	168,000	97,000	+71.3	1,630	1,492
Virginia	11,972	10,105	+18.5	11,395,000	8,366,000	+36.2	1,085	938
West Virginia	3,307	2,891	+14.4	1,437,000	1,302,000	+15.0	483	454
North Carolina	10,082	9,450	+ 6.7	4,904,000	4,455,000	+ 9.8	508	490
South Carolina	3,746	3,493	+ 7.3	2,300,000	1,809,000	+27.1	622	554
Georgia	5,309	4,372	+21.4	4,602,000	3,317,000	+38.7	937	833
Florida	5,214	4,385	+18.9	6,056,000	3,917,000	+54.6	1,301	920
Total South Atlantic	47,958	42,539	+12.7	38,690,000	29,649,000	+30.3	866	742
Kentucky	7,716	6,815	+13.2	3,492,000	2,523,000	+38.4	452	398
Tennessee	7,996	7,585	+ 5.4	4,572,000	3,827,000	+19.5	580	535
Alabama	12,326	12,001	+ 2.7	11,737,000	9,396,000	+24.9	960	895
Mississippi	3,475	3,001	+ 2.1	4,448,000	4,539,000	- 2.0	1,276	1,538
Total East So Central	31,513	29,649	+ 5.2	24,250,000	20,287,000	+19.5	774	753
Total above Eastern Area	493,229	451,222	+ 9.3	365,344,000	315,597,000	+15.8	775	745
FOR STATES IN WHICH IRRIGATION MAY BE INVOLVED								
Arkansas	3,253	3,202	+1.6	1,743,000	583,000	+33.5	550	198
Louisiana	2,447	2,218	+10.3	14,395,000	10,781,000	+24.3	5,988	5,173
Oklahoma	4,927	4,517	+ 9.1	3,762,000	3,033,000	+24.3	2,789	2,234
Texas	11,543	11,501	+ 0.4	28,466,000	32,270,000	-11.8	2,502	3,008
Total West So Central	22,170	21,438	+ 3.4	48,371,000	46,667,000	+ 3.7	2,226	2,335
Montana	2,377	2,192	+ 7.8	3,677,000	2,852,000	+28.9	1,586	1,366
Idaho	12,402	12,126	+ 2.2	23,816,000	22,081,000	+ 7.9	1,957	1,932
Wyoming	523	476	+ 9.9	543,000	574,000	- 5.4	1,243	1,324
Colorado	7,170	6,757	+ 6.1	5,959,000	5,063,000	+17.7	844	761
New Mexico	1,340	1,242	+ 7.9	1,699,000	1,522,000	+11.6	1,316	1,299
Arizona	4,110	3,805	+ 8.0	52,061,000	60,376,000	-13.8	13,153	15,868
Utah	15,443	15,062	+ 2.5	14,441,000	12,592,000	+14.7	944	853
Nevada	943	876	+ 7.6	1,816,000	971,000	+87.0	1,918	1,152
Total Mountain	44,308	42,536	+ 4.2	104,012,000	106,031,000	- 1.9	2,395	2,596
Washington	36,143	33,803	+ 6.9	92,159,000	84,094,000	+ 9.6	2,596	2,675
Oregon	16,388	15,767	+ 3.9	25,830,000	25,757,000	-21.0	1,617	1,630
California	86,548	85,153	+ 1.6	1,242,972,000	1,203,646,000	+ 3.3	14,509	14,677
Total Pacific	139,079	134,723	+ 3.2	1,360,963,000	1,320,497,000	+ 3.1	9,924	9,250
Total above Western Area	205,557	198,697	+ 3.3	1,513,344,000	1,473,195,000	+ 2.7	7,487	7,768

(Source of Data—Estimated by N.E.L.A. Statistical Department Based on Returns from Approximately 65 Per Cent of Industry)

TABLE IV—FARM HOME FACILITIES—NUMBER OF FARMS REPORTING TELEPHONES, WATER PIPED DWELLINGS AND ELECTRICALLY LIGHTED FARM HOMES—APRIL 1, 1930

Division or State	Total All Farms	Telephones		Water Piped Dwellings			Electric Lighted Farm Homes			
		Farms	%	In Farm House		In Bathroom	High Line Service		Farm Plants	Total
				Farms	%	Farms	Farms	%	Farms	%
Total United States	6,288,648	2,139,194	34.0	994,202	15.8	531,248	596,014	9.5	249,342	4.0
Maine	39,006	22,189	56.9	19,121	49.0	4,918	11,066	28.4	1,854	4.7
New Hampshire	14,206	9,313	65.5	10,995	73.8	3,857	5,164	34.6	996	6.7
Vermont	24,898	15,093	60.6	18,013	72.3	6,185	8,511	26.2	1,054	4.2
Massachusetts	25,598	16,581	64.8	19,083	74.5	10,939	13,380	54.6	2,057	8.0
Rhode Island	3,322	1,742	52.4	1,887	56.8	1,027	1,669	50.2	241	7.3
Connecticut	17,195	11,366	66.1	10,716	62.3	5,758	7,863	45.7	1,200	7.0
Total New England	124,925	76,284	61.1	79,815	63.9	32,684	46,253	37.0	7,402	5.9
New York	159,806	78,195	48.9	59,276	37.1	29,555	44,747	28.0	10,272	6.4
New Jersey	25,378	10,373	40.9	12,359	48.7	8,162	10,982	43.3	2,459	9.7
Pennsylvania	172,419	73,321	42.5	64,064	37.2	26,049	35,281	20.5	10,357	6.0
Total Middle Atlantic	357,603	161,879	45.3	135,699	37.9	63,766	91,010	25.5	23,088	6.4
Ohio	219,296	121,214	55.3	64,104	29.2	24,320	40,363	18.4	16,377	7.5
Indiana	181,570	110,333	60.8	35,451	19.5	14,380	18,756	10.3	11,570	6.4
Illinois	214,497	147,622	68.8	42,391	19.8	23,583	19,025	8.9	15,206	7.1
Michigan	169,372	73,757	43.5	40,672	24.1	15,673	25,890	15.3	8,895	5.2
Wisconsin	181,167	107,486	59.1	28,454	15.7	14,533	31,750	17.5	14,815	8.1
Total East No Central	966,502	560,462	58.0	211,272	21.9	92,489	135,784	14.1	65,872	6.9
Minnesota	185,255	114,692	61.9	23,124	12.5	11,183	12,602	6.8	10,740	5.8
Iowa	214,928	180,876	84.2	51,535	24.0	31,435	26,066	12.1	19,976	9.3
Missouri	255,940	137,712	53.8	10,881	4.2	10,881	12,655	4.9	7,568	3.0
North Dakota	77,975	31,678	40.6	5,844	7.5	2,537	1,766	2.2	4,426	5.7
South Dakota	83,157	44,608	53.6	12,089	14.5	4,657	2,605	3.1	6,465	7.8
Nebraska	129,458	93,888	72.8	38,357	29.6	17,817	8,104	6.2	13,272	10.2
Kansas	166,042	120,890	72.8	28,045	16.9	15,598	10,348	6.2	10,372	6.3
Total West No Central	1,112,755	724,545	65.1	180,402	16.2	94,108	74,146	6.7	72,823	6.5
Delaware	9,707	2,420	24.9	1,500	15.5	1,033	1,120	11.5	441	4.6
Maryland	43,203	11,935	27.6	10,354	24.0	6,173	6,289	14.6	2,856	6.6
Dist of Col	104	69	66.3	48	46.2	43	54	51.9	13	12.5
Virginia	170,610	30,418	17.8	15,291	9.0	10,032	8,430	4.9	4,579	2.7
West Virginia	82,641	28,117	34.0	9,650	11.7	3,848	2,859	3.4	2,471	3.0
North Carolina	279,708	19,852	7.1	9,308	3.3	5,351	8,984	3.2	6,022	2.2
South Carolina	157,931	6,357	4.0	5,176	3.3	3,757	3,105	2.0	2,962	1.8
Georgia	258,528	14,771	5.8	7,877	3.1	4,959	3,604	1.4	3,895	1.5
Florida	58,966	3,525	6.0	7,559	12.8	6,158	4,346	7.4	2,145	3.6
Total South Atlantic	1,058,468	117,464	11.1	66,763	6.3	41,354	38,791	3.7	25,382	2.4
Kentucky	246,492	61,631	25.0	8,378	3.4	5,128	6,110	2.5	4,581	1.8
Tennessee	245,657	45,205	18.4	8,018	3.3	4,903	6,828	2.8	3,182	1.3
Alabama	257,395	19,510	7.6	5,182	2.0	3,194	9,162	3.6	1,343	0.5
Mississippi	312,663	15,858	5.1	5,593	1.8	4,091	2,487	0.8	2,305	0.7
Total East So Central	1,062,214	142,204	13.4	27,171	2.6	17,316	24,587	2.3	11,411	1.1
Arkansas	242,334	25,046	10.3	3,690	1.5	2,392	2,925	1.2	2,196	0.9
Louisiana	161,445	6,106	3.8	3,964	2.5	3,841	1,948	1.2	2,225	1.4
Oklahoma	203,866	53,149	26.1	10,820	5.3	6,521	4,178	2.1	3,913	1.9
Texas	495,489	97,346	19.6	68,902	13.9	31,527	10,555	2.1	12,299	2.5
Total West So Central	1,103,134	181,647	16.5	88,376	8.0	50,281	19,607	1.7	20,633	1.9
Montana	47,495	9,697	20.4	5,382	11.3	2,608	2,011	4.3	1,536	3.2
Idaho	41,674	15,733	37.8	9,970	23.9	5,227	11,456	27.4	1,353	3.3
Wyoming	16,011	4,483	28.0	1,995	12.5	982	6,468	3.0	677	4.2
Colorado	59,956	23,877	39.8	12,314	20.5	6,183	6,548	10.9	2,845	4.8
New Mexico	31,404	2,879	9.2	2,804	8.9	1,626	1,135	3.6	556	1.8
Arizona	14,173	2,672	18.9	4,083	28.8	2,772	3,443	24.3	228	1.6
Utah	27,159	7,416	27.3	10,561	38.9	6,157	14,554	53.6	1,224	4.5
Nevada	3,442	1,460	42.4	1,215	35.3	748	903	26.2	236	6.9
Total Mountain	241,314	68,217	28.3	48,324	20.0	26,303	40,518	16.8	8,655	3.6
Washington	70,904	31,764	44.8	34,476	48.6	20,726	30,256	42.7	3,800	5.3
Oregon	55,153	26,557	48.2	24,265	44.0	15,217	15,693	28.5	2,704	4.8
California	135,676	48,171	35.5	91,639	72.0	77,004	79,369	58.5	6,572	4.8
Total Pacific	261,733	106,492	40.7	156,380	59.7	112,947	125,318	47.9	13,076	5.0

(Source of Data—High Line Service—N.E.L.A., All Other Data U. S. Census of Agriculture)

TABLE V—MAJOR FARM FACILITIES—NUMBER OF FARMS REPORTING AUTOMOBILES, MOTOR TRUCKS, TRACTORS, ELECTRIC MOTORS FOR FARM WORK AND STATIONARY ENGINES—APRIL 1, 1930

Division or State	Total all Farms	Automobiles		Motor Trucks		Tractors		Electric Motors		Stationary Engines	
		Farms	%	Farms	%	Farms	%	Farms	%	Farms	%
Total United States	6,288,648	3,650,003	58.0	845,335	13.4	851,457	13.5	256,663	4.1	945,000	15.0
Maine	39,006	23,015	59.0	9,879	25.3	3,214	8.2	3,447	8.8	7,005	18.0
New Hampshire	14,906	9,288	62.3	4,051	27.0	1,013	6.8	1,561	10.5	3,020	20.3
Vermont	24,898	15,825	63.6	4,625	18.6	2,342	9.4	2,358	9.5	8,437	33.9
Massachusetts	25,598	14,737	57.6	7,982	31.2	3,563	13.9	4,266	16.7	4,328	16.9
Rhode Island	3,322	2,055	61.9	1,366	41.1	516	15.5	646	19.4	544	16.4
Connecticut	17,195	10,646	61.9	5,425	31.5	2,463	14.3	2,514	14.6	4,494	26.1
Total New England	124,925	75,566	60.5	33,328	26.7	13,111	10.5	14,792	11.8	27,828	22.3
New York	159,806	115,010	72.0	54,084	33.8	37,790	23.6	16,012	10.2	50,094	31.3
New Jersey	25,378	17,782	70.1	12,504	49.3	7,241	28.5	4,102	16.2	6,953	27.4
Pennsylvania	172,419	121,292	70.3	43,168	25.0	31,688	18.4	12,197	7.1	46,807	27.1
Total Middle Atlantic	357,603	254,084	71.1	109,758	30.7	76,719	21.5	32,311	9.0	103,864	29.0
Ohio	219,296	172,078	78.5	36,693	16.7	50,693	23.1	14,000	6.4	45,108	20.6
Indiana	181,570	141,374	77.9	28,468	15.7	40,402	22.3	7,795	4.3	35,192	19.4
Illinois	214,497	170,806	79.5	38,877	18.1	66,172	30.8	10,452	4.9	66,640	31.1
Michigan	169,372	133,565	78.9	34,894	20.6	33,098	19.5	10,285	6.1	46,574	27.5
Wisconsin	181,767	152,485	83.9	50,108	27.6	48,630	26.8	22,812	12.6	88,364	48.6
Total East No Central	966,502	770,108	79.7	189,040	19.6	238,995	24.7	65,344	6.8	281,878	29.2
Minnesota	185,255	159,372	86.0	35,503	19.2	46,171	24.9	11,721	6.3	93,382	50.4
Iowa	214,928	193,810	90.2	31,874	14.8	63,166	29.4	17,277	8.0	94,772	44.1
Missouri	255,940	164,087	64.1	19,215	7.5	23,673	9.2	3,580	1.4	27,471	10.7
North Dakota	77,975	67,426	86.5	16,502	21.2	34,148	43.8	3,203	4.1	35,226	45.2
South Dakota	83,157	71,965	86.5	14,485	17.4	30,972	37.2	3,283	3.9	29,765	35.8
Nebraska	129,458	118,860	91.8	25,176	19.4	37,955	29.3	5,807	4.5	41,945	32.4
Kansas	166,042	145,224	87.5	32,009	19.3	59,075	35.6	5,101	3.1	34,428	20.7
Total West No Central	1,112,755	920,814	82.8	174,764	15.7	295,160	26.5	49,972	4.5	356,995	32.1
Delaware	9,707	7,498	77.2	2,781	28.6	1,447	14.9	384	4.0	1,453	15.0
Maryland	43,203	30,519	70.6	10,205	23.6	6,744	15.6	2,557	5.9	7,852	18.1
Dist of Columbia	104	42	40.3	27	26.0	15	14.4	7	6.7	8	7.7
Virginia	170,610	80,296	47.1	17,964	10.5	9,142	5.4	2,427	1.4	8,959	5.3
West Virginia	82,641	33,434	40.5	6,936	8.4	2,641	3.2	884	1.1	3,705	4.5
North Carolina	279,708	125,196	44.8	17,613	6.3	11,034	3.9	1,533	0.6	4,547	1.6
South Carolina	157,931	59,022	37.4	6,575	4.2	3,229	2.0	757	0.5	2,358	1.5
Georgia	255,598	85,276	33.4	15,036	5.9	5,349	2.1	968	0.4	4,130	1.6
Florida	58,966	24,161	41.0	10,852	18.4	4,382	7.4	1,592	2.7	3,603	6.1
Total South Atlantic	1,058,468	445,454	42.1	88,019	8.3	43,983	4.2	11,209	1.1	36,595	3.5
Kentucky	246,499	82,034	33.3	6,740	2.7	6,951	2.8	1,121	0.5	4,821	2.0
Tennessee	245,657	84,067	34.2	8,563	3.5	6,556	2.7	1,216	0.5	4,382	1.8
Alabama	257,325	71,167	27.6	12,169	4.7	4,259	1.7	678	0.3	2,154	0.8
Mississippi	312,663	83,372	26.7	15,762	5.0	4,818	1.5	494	0.2	1,927	0.6
Total East So Central	1,062,214	320,640	30.2	43,234	4.1	22,584	2.1	3,509	0.3	13,284	1.3
Arkansas	242,334	63,800	26.3	10,526	4.3	4,263	1.8	1,056	0.4	3,911	1.6
Louisiana	161,442	41,453	25.7	8,769	5.4	3,810	2.4	510	0.3	2,072	1.3
Oklahoma	203,866	117,537	57.7	23,039	11.3	23,328	11.4	1,888	0.9	8,499	4.2
Texas	495,489	280,758	56.7	49,966	10.1	31,776	6.4	4,051	0.8	16,189	3.3
Total West So Central	1,103,134	503,548	45.6	92,300	8.4	63,177	5.7	7,305	0.7	30,671	2.8
Montana	47,495	34,477	72.6	13,783	29.0	17,093	36.0	1,088	2.3	11,588	24.4
Idaho	41,674	30,776	73.8	5,986	14.4	4,377	10.5	4,406	10.6	8,252	19.8
Wyoming	16,011	11,462	71.6	3,820	23.9	3,749	23.4	315	2.0	2,929	18.3
Colorado	59,956	45,546	76.0	16,052	26.8	12,029	20.1	2,389	3.8	9,970	16.6
New Mexico	31,404	14,091	44.9	5,024	16.0	2,227	7.1	393	1.3	1,567	5.0
Arizona	14,173	8,211	57.9	2,719	19.2	2,043	14.4	1,427	10.1	2,357	16.6
Utah	27,159	16,343	60.2	3,566	14.7	1,335	4.9	1,269	4.7	1,111	4.1
Nevada	3,442	2,397	69.6	1,118	32.5	318	9.2	564	16.4	897	26.1
Total Mountain	241,314	163,303	67.7	52,488	21.8	43,171	17.9	11,751	4.9	38,671	16.0
Washington	70,904	50,769	71.6	17,622	24.9	7,890	11.1	10,751	15.2	15,373	21.7
Oregon	55,153	41,511	75.3	9,110	16.5	9,157	16.6	6,043	11.0	13,633	24.7
California	135,676	104,206	76.8	35,674	26.3	37,510	27.6	43,676	32.2	26,208	19.3
Total Pacific	261,733	196,486	75.1	62,406	23.8	54,557	20.8	60,470	23.1	55,214	21.1

(Source of Data—U. S. Census of Agriculture)

TABLE VI—GENERAL FARM IMPROVEMENTS—KIND OF ROADS PASSING FARM DWELLINGS—APRIL 1, 1930

Division and State	Total All Farms	Farms Located on Surface Roads										Improved Dirt Roads	Unimproved Dirt Roads	Total All other Roads
		Hard Surface Roads		Total		%	Semi-surface		Total Surface	%				
		Concrete	Brick	Asphalt	Macadam		Gravel	Sand						
Total United States	6,288,648	202,594	13,180	72,011	306,397	594,182	9.4	1,278,855	156,789	2,029,826	32.3	1,638,954	2,279,989	339,879
Maine	39,006	358		230	2,901	3,493	9.0	12,503	186	16,182	41.5	4,971	15,904	1,949
New Hampshire	14,906	283	-	458	2,912	3,653	24.5	2,181	18	5,852	39.3	1,793	6,607	654
Vermont	24,898	675	-	19	559	1,253	5.0	9,354	80	10,687	42.9	4,927	8,739	545
Massachusetts	25,598	623	-	915	7,578	9,219	36.0	5,217	121	14,557	56.9	3,404	6,575	1,062
Rhode Island	3,322	152	-	149	981	1,282	38.6	397	1	1,680	50.1	543	969	130
Connecticut	17,195	1,094	-	121	3,863	5,078	29.5	1,808	50	6,936	40.3	2,811	6,794	654
Total New England	124,925	3,185	7	1,892	18,894	23,978	19.2	31,460	456	55,894	44.7	18,449	45,588	4,994
New York	159,806	17,636	827	2,844	38,759	60,066	37.6	14,344	263	74,673	46.7	15,759	63,190	6,184
New Jersey	25,378	3,046	5	930	4,548	8,529	33.6	6,805	184	15,518	61.1	2,363	6,472	1,025
Pennsylvania	172,419	14,713	882	969	21,514	38,078	22.1	14,684	810	53,572	31.1	20,557	91,241	7,049
Total Middle Atlantic	357,603	35,395	1,714	4,743	64,821	106,673	29.8	35,333	1,257	143,763	40.2	38,679	160,903	14,258
Ohio	219,296	11,020	7,119	2,827	55,104	76,070	34.7	78,598	590	155,258	70.8	9,604	45,538	8,896
Indiana	181,570	9,125	544	1,470	21,958	33,097	18.2	105,936	371	139,404	76.8	6,790	27,746	7,630
Illinois	214,497	19,130	689	1,966	3,580	23,595	11.0	44,752	343	68,690	32.0	57,149	79,175	9,483
Michigan	169,372	9,562	15	1,249	6,445	17,271	10.2	79,231	2,124	98,626	58.2	23,578	41,006	6,162
Wisconsin	181,767	11,185	5	117	4,451	15,758	8.7	86,632	1,487	103,877	57.1	34,521	37,951	5,418
Total East No Central	966,502	60,022	8,372	5,859	91,538	165,791	17.2	395,149	4,915	565,855	58.5	131,642	231,416	37,589
Minnesota	185,255	2,259	20	197	1,355	3,831	2.1	75,942	1,318	81,091	43.8	50,692	46,835	6,637
Iowa	214,928	7,803	276	126	7,330	8,935	4.2	47,902	521	57,355	26.7	65,295	85,627	6,648
Missouri	255,940	6,903	62	506	3,816	11,287	4.4	40,275	416	51,978	20.3	71,832	120,783	11,547
North Dakota	77,975	12	-	8	63	77	0.1	5,142	97	5,316	6.8	38,898	30,062	3,699
South Dakota	83,157	47	1	29	29	85	0.1	11,346	3	11,434	13.7	42,455	25,594	3,674
Nebraska	129,458	641	176	54	35	906	0.7	15,310	497	16,713	12.8	71,749	36,194	4,802
Kansas	166,042	3,039	601	222	1,282	5,124	3.1	13,813	2,250	21,187	12.8	83,071	56,565	5,219
Total West No Central	1,112,755	20,704	1,136	1,115	7,290	30,245	2.7	209,730	5,102	245,077	22.0	423,792	401,660	42,226
Delaware	9,707	1,953	2	93	914	2,962	30.5	688	115	3,765	38.8	1,614	3,942	386
Maryland	43,203	4,830	10	176	7,097	12,113	28.0	5,147	214	17,474	40.0	6,225	17,752	1,752
Dist of Columbia	104	13	-	29	29	71	68.3	16	-	87	83.7	3	13	1
Virginia	170,810	2,328	14	2,810	14,485	19,637	11.5	16,432	12,602	48,671	28.5	31,167	81,709	9,063
West Virginia	82,641	2,791	409	1,793	4,685	9,638	11.7	4,724	513	14,875	18.0	10,184	51,602	5,980
North Carolina	279,708	11,160	331	6,096	4,914	22,501	8.0	17,732	42,828	83,061	29.7	74,074	101,365	21,208
South Carolina	157,931	4,429	25	1,935	4,782	7,171	4.5	5,661	25,435	38,267	24.2	44,165	68,188	7,311
Georgia	255,998	2,907	9	2,875	898	6,689	2.6	12,079	23,161	41,929	16.4	89,932	109,565	14,172
Florida	58,966	661	721	6,897	3,384	11,663	19.8	2,323	4,924	18,910	32.1	10,848	22,950	6,258
Total South Atlantic	1,058,468	31,032	1,521	22,704	37,188	92,445	8.7	64,802	109,792	267,039	25.2	268,212	457,086	66,131
Kentucky	246,499	1,769	29	2,343	33,222	37,363	15.2	39,576	814	77,753	31.5	31,079	117,256	20,411
Tennessee	245,657	4,943	7	4,511	13,972	23,433	9.8	56,857	933	81,223	33.1	44,879	104,724	14,831
Alabama	297,395	1,679	16	1,816	1,005	4,516	1.5	43,214	12,794	60,524	23.5	82,661	101,316	12,894
Mississippi	312,663	3,484	111	345	22	3,962	1.3	110,215	5,450	119,627	38.3	84,146	95,899	12,991
Total East So Central	1,062,214	11,875	163	9,015	48,221	69,274	6.5	249,862	19,991	339,127	31.9	242,765	419,195	61,127
Arkansas	242,334	3,011	1	3,440	312	6,764	2.8	35,094	1,913	43,771	18.1	65,836	113,687	19,040
Louisiana	161,445	1,469	19	530	495	2,513	1.6	52,813	681	56,007	34.7	37,223	60,807	7,408
Oklahoma	203,866	3,124	85	494	85	3,788	1.9	10,741	1,809	16,338	8.0	101,265	72,032	14,230
Texas	495,489	6,489	74	12,941	3,930	23,434	4.7	53,833	9,407	86,574	17.5	202,394	175,776	30,645
Total West So Central	1,103,134	14,093	179	17,405	4,822	36,499	3.3	152,481	13,810	202,790	18.4	406,718	422,303	71,323
Montana	47,495	47	-	367	70	117	0.2	5,656	40	5,813	12.2	17,617	21,381	2,684
Idaho	41,674	172	2	9	1,270	1,811	4.3	14,997	332	17,140	41.1	9,353	12,834	2,347
Wyoming	16,011	33	-	9	52	94	0.6	1,428	4	1,526	9.5	5,223	8,032	1,230
Colorado	59,956	839	1	28	149	1,017	1.7	14,262	161	15,440	25.8	22,602	18,072	3,842
New Mexico	31,404	357	-	10	222	589	1.9	3,362	254	4,205	13.4	6,147	17,750	3,302
Arizona	14,173	1,187	-	150	75	1,412	10.0	1,759	10	3,181	22.4	3,442	5,085	2,465
Utah	27,159	1,703	-	292	812	2,807	10.3	9,606	354	12,767	47.0	5,004	7,247	2,141
Nevada	3,442	71	-	8	98	177	5.1	478	15	670	19.5	977	1,606	189
Total Mountain	241,314	4,409	3	864	2,748	8,024	3.3	51,548	1,170	60,742	25.2	70,365	92,007	18,200
Washington	70,904	4,957	81	790	1,792	7,620	10.7	38,222	72	45,914	64.8	6,967	13,943	4,080
Oregon	55,153	1,368	2	2,870	6,175	10,415	18.9	25,620	30	36,065	65.4	4,580	11,488	3,020
California	135,676	15,554	2	4,754	22,908	43,218	31.9	67,560	194	67,560	49.8	26,785	24,400	16,931
Total Pacific	261,733	21,879	85	8,414	30,875	61,253	23.4	87,990	296	149,539	57.1	38,332	49,831	24,031

(Source of Data—U. S. Census of Agriculture)

TABLE VII—BASIC DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY—NUMBER OF CUSTOMERS, KILOWATTS OF GENERATING CAPACITY AND KILOWATTHOURS GENERATED—YEAR 1931

	Total Number of Customers	Kilowatt Generating Capacity	Kilowatt Hours Generated
Total United States	24,497,670	33,076,906	85,575,307,000
Maine	190,603	293,095	803,318,000
New Hampshire	121,575	285,888	592,921,000
Vermont	79,459	176,435	456,284,000
Massachusetts	1,165,282	1,101,714	2,407,568,000
Rhode Island	190,319	242,950	436,364,000
Connecticut	465,392	542,865	1,162,271,000
Total New England	2,212,630	2,542,947	5,858,726,000
New York	3,793,254	4,130,051	11,256,726,000
New Jersey	1,172,332	967,615	3,282,042,000
Pennsylvania	2,073,712	2,599,776	7,232,712,000
Total Middle Atlantic	7,039,298	7,697,442	21,771,480,000
Ohio	1,504,131	2,122,017	5,434,467,000
Indiana	696,974	1,010,977	2,803,289,000
Illinois	1,883,870	2,536,646	6,304,175,000
Michigan	1,085,348	1,594,788	3,701,086,000
Wisconsin	641,230	857,797	1,978,353,000
Total East No Central	5,811,553	8,122,225	20,221,370,000
Minnesota	463,357	477,986	1,143,886,000
Iowa	473,172	566,549	1,461,193,000
Missouri	665,120	749,696	1,334,205,000
North Dakota	68,334	59,344	137,196,000
South Dakota	83,839	63,605	102,201,000
Nebraska	245,460	233,878	595,190,000
Kansas	348,395	373,656	917,768,000
Total West No Central	2,347,677	2,524,714	5,691,639,000
Delaware	48,737	7,265	5,468,000
Maryland	325,802	615,347	1,693,664,000
Dist of Columbia	130,707	208,000	515,295,000
Virginia	262,960	422,697	1,051,317,000
West Virginia	191,328	528,122	1,850,685,000
North Carolina	262,779	741,975	1,229,913,000
South Carolina	110,476	687,213	1,372,156,000
Georgia	220,894	427,571	838,256,000
Florida	251,984	359,191	642,434,000
Total South Atlantic	1,805,667	3,997,381	9,203,188,000
Kentucky	281,961	338,722	744,434,000
Tennessee	256,646	343,525	802,424,000
Alabama	185,308	701,166	1,634,682,000
Mississippi	96,272	60,230	53,049,000
Total East So Central	820,187	1,443,643	3,234,589,000
Arkansas	123,632	148,955	103,897,000
Louisiana	207,183	264,132	1,070,549,000
Oklahoma	281,952	333,074	783,066,000
Texas	683,575	928,242	2,518,192,000
Total West So Central	1,296,342	1,674,403	4,475,704,000
Montana	84,147	309,511	964,892,000
Idaho	75,713	206,150	692,777,000
Wyoming	33,642	28,017	56,713,000
Colorado	207,866	199,668	484,407,000
New Mexico	35,256	84,791	179,658,000
Arizona	71,673	128,805	393,861,000
Utah	107,776	140,130	276,483,000
Nevada	17,716	10,777	19,027,000
Total Mountain	633,789	1,107,849	3,067,812,000
Washington	425,783	857,972	2,547,236,000
Oregon	233,447	325,289	1,164,800,000
California	1,871,297	2,683,041	8,338,757,000
Total Pacific	2,530,527	3,866,302	12,050,793,000

(Source of Data—N.E.L.A. Statistical Department)

vice, for the low revenue then apparent. In other words, it became apparent that the secret of success in rural electrification was volume use of energy in such a manner as to yield returns in agriculture satisfactory to the farmer. To attempt to meet this problem, the Committee on the Relation of Electricity to Agriculture was organized in 1923. This committee was organized by representatives of the American Farm Bureau Federation and the National Electric Light Association. The present membership consists of representatives from the following organizations:

- American Farm Bureau Federation
- American Home Economics Association
- American Society of Agricultural Engineers
- General Federation of Women's Clubs

- Individual Plant Manufacturers
- National Association of Farm Equipment Manufacturers
- National Electric Light Association
- National Electric Manufacturers' Association
- National Grange
- State Project Directors
- U. S. Department of Agriculture
- U. S. Department of Commerce
- U. S. Department of Interior
- Members-at-Large

State Committees

When the problems confronting this committee were analyzed it became evident that there was relatively little information available regarding how the farmer could use electricity. Acting in the light of this analysis, a nation-wide plan was put in motion to obtain information on possible uses and

stimulate the development of new uses. The committee planned, as far as possible, to use existing agencies for this purpose, thereby creating a minimum of new organizations. Consequently state committees were organized, the membership for these being drawn from existing organizations. Committees were formed in the following states:

- Alabama
- California
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Louisiana
- Michigan
- Minnesota
- Missouri
- Nebraska
- New Hampshire
- New Jersey
- New York
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- South Carolina
- South Dakota
- Texas
- Virginia
- Washington
- Wisconsin

It was the primary function of these state committees to organize and support an investigation program which would yield information relating to the use of electricity in agriculture and to see that such information was made available to those who desired it. The responsibility for conducting the investigations was placed by the state committees in the hands of officers of our state agricultural colleges or experiment stations. Results have followed this plan of action. In addition to these activities and to further stimulate the development of the possibilities of electricity on the farm, the National Rural Electric Project, located near College Park, Maryland, was organized in 1928. Here investigation work has been conducted both in the laboratory and on the farm. This project will be completed in 1933. In 1931 a Report on Farm Electrification Research was published as C.R.E.A. Bulletin, Vol. VI, No. 1. This report said in part:

This survey of research, although including only a part of the active agencies, has brought to light 211 investigations connected with or stimulated by the Committee on the Relation of Electricity to Agriculture, 493 active projects in colleges, universities and the United States Department of Agriculture, related to rural electrification, 118 undertakings of an investigational nature by utilities and commercial concerns and 39 investigations in private and other laboratories. Eighty-five suggestions for new studies have also been received. Twenty-eight state experiment stations and a number of private laboratories, power companies and farms were visited in making the survey. Magazines, journals of professional societies, chemical and biophysical abstracts and the Experiment Station Record furnish an unending succession of references or at least clues indicating the location and progress of related investigations. Time has permitted the examination of only a limited number of these. Furthermore, there is every promise that investigation and research work

TABLE VIII—PRESENT AND POTENTIAL ELECTRIFIED HOMES—POPULATION, FAMILIES AND WIRED HOMES FOR URBAN, FARM AND RURAL AREAS—APRIL 1, 1930

	Population				Total Number of Families (Homes)				Homes Receiving Electric Service			
	Urban		Rural		Urban	Rural		Total	Urban	Rural		Total
	Farm	Non-Farm	Farm	Non-Farm		Farm	Non-Farm			Farm	Non-Farm	
Total United States	68,954,823	30,157,513	23,662,710	122,775,046	78,328	37,990	81,508	197,826	15,955,068	530,060	3,564,322	20,049,450
Maine	321,506	161,429	314,488	797,423	67,461	37,931	81,508	119,337	78,076	8,837	66,092	154,005
New Hampshire	273,079	54,911	465,293	379,611	29,848	25,217	34,123	89,188	58,656	3,258	35,901	97,815
Vermont	118,766	111,898	128,947	359,611	29,848	25,217	34,123	89,188	6,276	3,188	81,749	65,464
Massachusetts	3,831,426	80,309	337,879	4,249,614	151,888	2,449	11,006	185,343	880,208	524	15,705	965,145
Rhode Island	635,429	10,289	41,779	687,497	272,571	18,139	97,835	388,645	146,510	6,268	94,539	162,789
Connecticut	1,131,770	80,247	394,886	1,606,903	272,571	18,139	97,835	388,645	15,572	28,401	325,057	376,379
New England	6,311,976	499,083	1,355,282	8,166,341	272,571	18,139	97,835	388,645	1,468,139	28,401	325,057	1,821,597
New York	10,521,952	706,446	1,359,668	12,588,066	1,160,463	232,759	297,696	1,697,918	2,648,140	41,717	309,927	2,999,784
New Jersey	3,339,244	121,008	581,082	4,041,334	471,326	198,419	173,321	843,066	767,094	8,462	140,633	916,189
Pennsylvania	6,533,511	846,240	2,251,599	9,631,350	1,160,463	232,759	297,696	1,697,918	1,403,944	32,790	296,109	1,732,843
Middle Atlantic	20,334,707	1,573,694	4,192,349	26,260,750	1,160,463	232,759	297,696	1,697,918	4,819,178	82,969	746,669	5,648,816
Ohio	4,507,371	1,004,288	1,135,038	6,646,697	1,160,463	232,759	297,696	1,697,918	1,086,274	38,044	186,416	1,310,734
Indiana	1,795,892	808,981	633,630	3,238,503	471,326	198,419	173,321	843,066	440,206	18,005	131,490	589,701
Illinois	5,635,727	991,401	1,003,526	7,630,654	1,160,463	232,759	297,696	1,697,918	1,392,061	17,961	190,757	1,600,779
Michigan	3,302,075	775,436	764,814	4,842,325	390,678	188,125	133,086	711,889	750,270	24,547	158,165	932,982
Wisconsin	1,553,843	873,008	512,155	2,939,006	390,678	188,125	133,086	711,889	370,348	30,111	121,772	522,231
East No Central	16,794,908	4,453,114	4,049,163	25,297,185	1,160,463	232,759	297,696	1,697,918	4,039,159	128,668	788,600	4,958,427
Minnesota	1,257,616	888,049	418,288	2,563,953	262,354	221,078	152,272	635,704	291,245	10,876	71,549	373,670
Iowa	979,292	964,689	526,988	2,470,969	262,354	221,078	152,272	635,704	241,415	22,904	133,872	398,191
Missouri	1,859,119	1,108,969	661,278	3,629,367	492,034	267,958	179,484	939,476	436,107	11,394	104,402	551,903
North Dakota	113,306	396,871	177,106	680,845	25,929	77,647	41,429	145,005	22,954	1,665	23,576	48,195
South Dakota	130,907	389,431	172,511	692,849	32,752	83,463	44,798	161,013	30,013	2,500	30,599	63,112
Nebraska	486,107	582,981	308,875	1,377,963	125,603	137,780	85,416	342,993	119,434	7,474	71,141	198,049
Kansas	729,834	704,601	446,564	1,880,999	198,703	167,094	121,331	487,188	182,309	94,115	94,115	286,149
West No Central	5,556,181	5,035,561	2,705,173	13,296,915	198,703	167,094	121,331	487,188	1,323,477	66,538	529,254	1,919,269
Delaware	123,146	46,302	68,932	238,380	29,996	10,723	18,373	59,092	24,632	1,057	12,478	38,167
Maryland	974,869	236,172	420,485	1,631,526	236,036	50,024	99,059	385,179	201,017	5,850	69,069	275,936
Dist of Columbia	486,869	0	0	486,869	125,554	0	0	125,554	104,154	0	0	104,154
Virginia	785,537	948,746	687,568	2,421,851	187,241	188,750	153,098	529,089	158,523	8,047	52,152	218,722
West Virginia	491,504	447,750	789,351	1,729,205	116,776	88,142	169,023	373,941	98,710	2,528	48,406	149,644
North Carolina	809,847	1,597,220	763,209	3,170,276	180,444	298,922	164,667	644,033	138,347	8,454	68,919	213,720
South Carolina	371,080	914,098	453,587	1,738,765	88,624	174,334	102,721	365,680	55,767	2,697	26,300	84,764
Georgia	895,492	1,413,719	599,295	2,908,506	224,104	285,898	142,791	652,793	122,705	2,511	38,151	163,367
Florida	759,778	274,949	433,484	1,468,211	202,248	59,265	114,286	375,499	150,606	3,386	29,112	183,104
South Atlantic	5,698,122	5,878,956	4,216,511	15,793,589	1,391,083	1,156,758	964,019	3,511,860	1,054,461	34,550	342,587	1,431,578
Kentucky	799,026	1,174,232	641,331	2,614,589	207,470	251,895	150,040	609,405	183,454	5,737	52,350	241,541
Tennessee	896,538	1,213,065	506,923	2,616,526	225,234	258,554	116,837	600,625	166,231	6,277	32,175	204,683
Alabama	744,273	1,336,409	565,566	2,646,248	182,635	273,773	135,217	591,625	112,140	8,506	23,208	149,854
Mississippi	338,850	1,360,729	310,242	2,009,821	87,231	304,490	79,983	471,704	47,379	1,972	13,621	72,972
East So Central	2,777,687	5,084,435	2,024,092	9,887,214	702,570	1,088,712	482,077	2,273,359	509,204	22,492	137,354	669,050
Arkansas	382,878	1,117,380	354,274	1,854,482	99,171	247,673	91,795	438,639	67,105	2,423	27,427	96,955
Louisiana	833,532	826,882	441,179	2,101,593	204,438	175,881	105,244	485,363	137,133	1,120	28,549	166,802
Oklahoma	822,681	1,021,174	553,185	2,396,040	212,625	215,866	135,673	564,164	164,803	3,699	54,235	222,737
Texas	2,342,553	1,092,814	1,092,814	5,528,175	212,625	215,866	135,673	564,164	435,565	8,228	102,107	545,900
West So Central	4,427,439	5,307,939	2,441,452	12,176,830	702,570	1,088,712	482,077	2,273,359	804,506	15,470	212,318	1,032,394
Montana	181,036	203,962	152,508	537,606	46,880	49,029	40,301	136,210	44,747	1,876	19,975	66,598
Idaho	129,507	186,100	129,425	445,032	33,105	41,890	33,049	108,044	32,448	10,875	23,158	66,481
Wyoming	70,097	281,038	82,863	434,998	18,673	17,092	21,122	56,887	14,583	408	11,144	26,135
Colorado	519,882	281,038	234,371	1,035,291	141,338	67,092	21,122	267,324	127,764	6,109	36,036	169,909
New Mexico	106,816	157,906	158,595	423,317	26,331	34,280	37,935	98,546	21,057	971	7,409	29,437
Arizona	149,856	98,819	186,898	435,573	38,024	20,967	47,001	105,992	37,950	3,398	12,921	54,269
Utah	266,264	106,667	134,916	507,847	63,985	21,191	30,760	115,936	62,963	12,794	18,705	94,462
Nevada	34,464	16,296	40,298	91,058	9,693	3,678	12,098	25,469	8,223	876	4,165	13,264
Mountain	1,457,922	1,123,693	1,120,174	3,701,789	378,029	252,929	283,450	914,408	349,735	37,307	133,513	520,552
Washington	884,539	300,143	378,714	1,563,396	244,980	76,402	102,451	423,833	235,891	29,130	75,962	340,983
Oregon	489,742	221,545	242,495	953,786	139,538	57,239	69,551	266,328	132,629	15,186	47,178	194,993
California	4,160,596	579,350	937,305	5,677,251	1,395,538	57,239	69,551	266,328	1,218,589	69,369	225,830	1,513,788
Pacific	5,534,881	1,101,038	1,558,514	8,194,433	1,395,538	57,239	69,551	266,328	1,587,109	113,685	348,970	2,049,764

(Source of Data—Population and Families from the 15th Census of the U. S. Missing Data Available by Dec. 1, 1932. Wired Homes—N.E.L.A. Statistical Dept.)

in this field will actively continue as those responsible for such activities have sensed unusual possibilities.

Bibliography of Publications

The results of the nation-wide investigation work have been made available through some 300 publications on various phases of this problem which have been issued by the Agricultural Experiment Stations, Agricultural Extension Service, State Committees on the Relation of Electricity to Agriculture, the National Committee on the Relation of Electricity to Agriculture, electric light and power companies, manufacturing companies and other groups, interested in this problem. A bibliography of the more important of these publications is given in C.R.E.A. Bulletin, Vol. VII, No. 1. In addition to this, the C.R.E.A. News Letter, issued from time to time, contains a running bibliography of current publications. It can truly be said that today the publications from these sources are looked upon as standard not only in the United States, but in many foreign countries.

Farm Equipment Committee Organized

There have been listed 227 uses for electricity on the farm, and 190 uses in industries located in rural territory. Even though there is some duplication in these two lists, the numbers are of sufficient size to indicate interesting possibilities.

As the investigation work progressed and new applications were proved to be practicable, the problem of getting suitable electrically operated equipment from the manufacturer to the farmer became of increasing importance. In order to deal with this problem in which many groups are involved, including manufacturers, jobbers, dealers and utility men, a Farm Equipment

Committee was organized in 1927 by the Commercial National Section of the Association. Thus constructive attention is being given to the important matter of seeing that so far as possible, the farmer is afforded every opportunity to obtain the proper equipment for the various operations on his farm.

Employment of Especially Qualified Rural Service Men

The Rural Electric Service Committee early advocated the employment by electric light and power companies of men especially qualified to handle rural electric development. In some cases companies established rural service departments; in other instances these men were located with one of the established departments. Today there are approximately 1,000 men with electric light and power companies devoting part or full time to extending electric service into the country and developing the load on existing lines.

To further train these men, agricultural colleges have been offering Rural Electric Short Courses where the work is especially designed to assist the rural service representative to more efficiently meet the problems of his territory. For the past 4 years from 5 to 10 of these short courses have been held annually.

Service Also to Small Hamlets

In addition to placing a new source of energy at the disposal of the farmer, the rural electrification movement has brought electric service to many other country residences and businesses. In some parts of the East there have been from 3 to 6 rural residential and business customers connected for each farm customer connected. In the Middle West the situation is just the reverse, there being 8 or 10 farms

served for each non-farming customer. Taking the country as a whole it is probably conservative to estimate the number of non-farming rural customers at twice the farming customers. This would make a total of approximately 2,000,000 rural customers located outside of incorporated municipalities.

Rural Line Costs

Along with these developments the engineers of the industry have been working upon the problem of reducing the cost of rural lines. Progress has been made here also. The tendency has been to go to minimum requirements, but experience is demonstrating that the farmer demands a service practically as reliable as his city cousin enjoys. Furthermore, as the rural load develops, the demand for reliability and capacity increases also. Thus efforts have been directed toward developing a type of line of minimum standards which can be improved as conditions warrant with a minimum additional outlay for labor and materials.

A Mutual Problem

In this report there are depicted some of the salient points of the preliminary stages of the movement to make electricity available and useful to American agriculture. The work is only just started. The cooperative activity between the two great industries has led the way and been the inspiration in this far-reaching development.

The achievements indicate, far better than words can describe, the willingness of the leaders of the electric light and power industry to assume responsibility for extending electric service to the farmers of the nation, and an equal willingness on the part of the farmers to use this service to the economic and social benefit of American agriculture.

RURAL ELECTRIC SERVICE COMMITTEE

(Administrative year, July 1, 1931—June 30, 1932)

SCOPE: *To make a study of the problems connected with rural electric service; to collect accurate information on the cost of this service to the utility; to determine the value of this service to the rural customers; to analyze the various rules, methods of financing and forms of rural rates now being used; to assist in the development of farm equipment suitable for electric drive; to assist in determining the proper standards of rural line construction and to assist the Committee on the Relation of Electricity to Agriculture in carrying on this work; to assist in the development of rural service departments in public utility organizations and to assist in the building of electric power load on the farm.*

Chairman, H M WEATHERS, Alabama Power Co, Birmingham, Ala

Geographic Division Representatives

Canadian—F L FOSTER, Gatineau Power Co, Ottawa, Can
Eastern—C E OAKES, Pennsylvania Power & Light Co, Allentown, Pa
East Central—L W McLELLAN, Kentucky Utilities Co, Louisville, Ky
Great Lakes—C V SORENSON, Traction Terminal Bldg, Indianapolis, Ind
Middle West—H S HINRICHS, Kansas Power & Light Co, Topeka, Kan
New England—F L RIMBACH, New England Power Co, Worcester, Mass

North Central—F F FINNEY, Eastern Minnesota Power Corp, Amery, Wis
Northwest—T DALZELL, The California Oregon Power Co, Klamath Falls, Ore
Pacific Coast—A M FROST, Pacific Gas and Electric Co, San Francisco, Cal
Rocky Mountain—R R ROWELL, Western Colorado Power Co, Delta, Colo
Southeastern—E C EASTERN, Alabama Power Co, Birmingham, Ala
Southwestern—JOE A WHITE, West Texas Utilities Co, Abilene, Texas

Members-at-Large

F W BAGNALL, The Detroit Edison Co, Detroit, Mich
F A BELDEN, The Edison Electric Illuminating Co, Boston, Mass
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J W CARPENTER, Texas Power & Light Co, Dallas, Texas
HAROLD COLE, The Detroit Edison Co, Detroit, Mich
HARRIS E DEXTER, Central Hudson Gas & Electric Corp, Poughkeepsie, N Y
ROY T DUNCAN, The Detroit Edison Co, Detroit, Mich
THOMAS D FULFORD, Virginia Electric & Power Co, Norfolk, Va
HENRY J GILLE, Puget Sound Power & Light Co, Seattle, Wash
DWIGHT GRIFFIN, Public Service Co of Northern Illinois, Chicago, Ill
E P GROSS, Central Public Service Corp, Chicago, Ill
EUGENE HOLCOMB, Consumers Power Co, Jackson, Mich
ARTHUR HUNTINGTON, Iowa Railway & Light Corp, Cedar Rapids, Ia
E F KELLY, Central Illinois Public Service Co, Springfield, Ill

D A LEWIS, Associated Gas & Electric Co, Oneonta, N Y
K R MACKINNON, Electric Bond & Share Co, New York, N Y
L A McARTHUR, Pacific Power & Light Co, Portland, Ore
W T McCASKEY, Middle West Utilities Co, Chicago, Ill
MRS VERA B MEACHAM, Wisconsin Power & Light Co, Madison, Wis
G C NEFF, Wisconsin Power & Light Co, Madison, Wis
C H PORTER, Kansas City Power & Light Co, Carrollton, Mo
T E ROACH, National Electric Power Co, New York, N Y
K M ROBINSON, Idaho Power Co, Boise, Idaho
CHARLES F STUART, Northern States Power Co, Minneapolis, Minn
W E WELSH, Pennsylvania Power & Light Co, Allentown, Pa
E A WHITE, 58 East Washington St, Chicago, Ill
F M WIGSTEN, Central Hudson Gas & Electric Corp, Poughkeepsie, N Y